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COMPREHENSIVE STUDY OF WATER AND RELATED LAND RESOURCES. PUGET --ETC(U)
MAR 70 A T NEALE, S STEINBORN, L F KEHNE

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Comprehensive Study of Water
and Related Land Resources

Puget Sound and Adjacent Waters

State of Washington

Appendix IV
Economic Environment

Puget Sound Task Force—Pacific Northwest River Basins Commission

March 1970

The Comprehensive Study of Puget Sound and Adjacent Waters covers the area formed by the

This expansion was necessary to conform with availability of essential economic data. The economic

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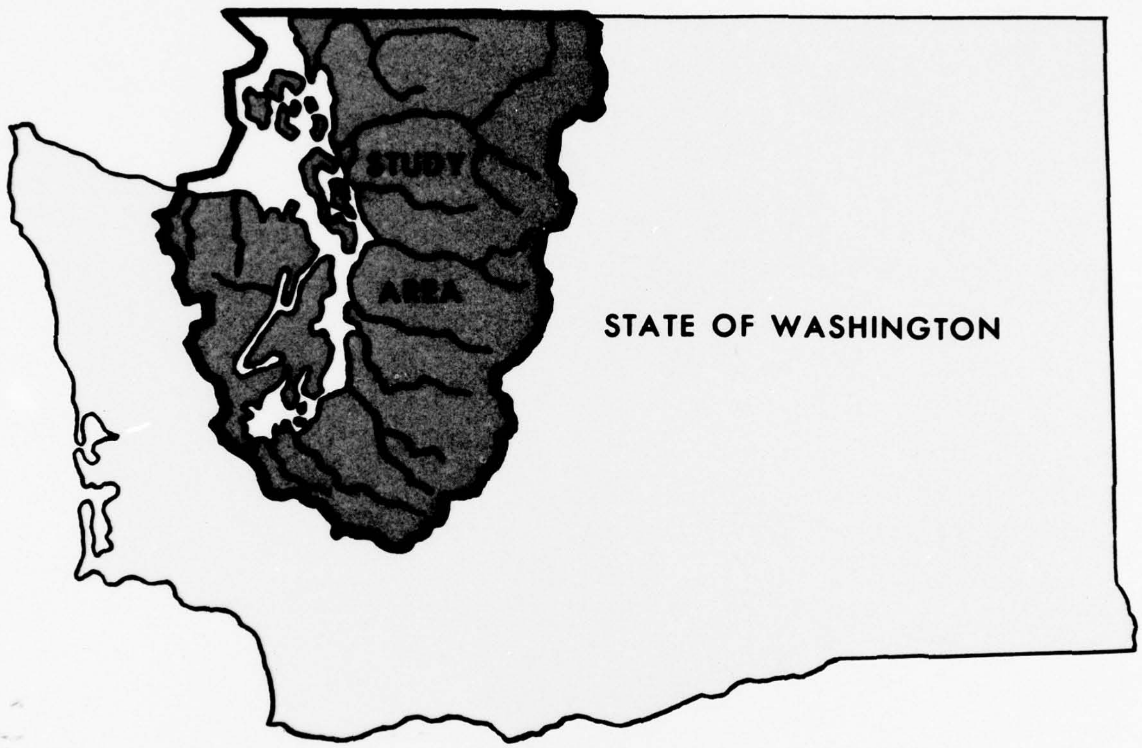

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Comprensive Study of Water and Related Land Resources.

Puget Sound and Adjacent Waters.

APPENDIX IV.

ECONOMIC ENVIRONMENT,

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ACKNOWLEDGMENTS

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FOREWORD

Appendix IV, Economic Environment, presents data and information on economic activities within the area studied under the Comprehensive Water Resource Study of Puget Sound and Adjacent Waters and projects its economy for the year 1980, 2000, and 2020. It is one of the technical appendices providing supporting data for the overall water resource study.

The Summary Report is supplemented by 15 appendices. Appendix I contains a Digest of Public Hearings. Appendices II through IV contain environmental studies. Appendices V through XIV each contain an inventory of present status, present and future needs, and the means to satisfy the needs, based upon a single use or control of water. Appendix XV contains the formulation of basin plans.

River-basin planning in the Pacific Northwest was initiated under the guidance of the Columbia Basin Inter-Agency Committee (CBIAC) and completed under the aegis of the Pacific Northwest River Basins Commission. A task Force for Puget Sound and Adjacent Waters was established in 1964 by the CBIAC for the purpose of making a water resource study of the Puget Sound based upon guidelines set forth in Senate *Document 97, 87th Congress, Second* Session.

The Puget Sound Task Force consists of ten members, each representing a major State or Federal agency. All State and Federal agencies having some authority over or interest in the use of water resources are included in the organized planning effort.

The published report is contained in the following volumes:

SUMMARY REPORT

APPENDICES

I. Digest of Public Hearings
II. Political and Legislative Environment
III. Hydrology and Natural Environment
IV. Economic Environment
V. Water-Related Land Resources
  a. Agriculture
  b. Forests
  c. Minerals
  d. Intensive Land Use
  e. Future Land Use
VI. Municipal and Industrial Water Supply
VII. Irrigation
VIII. Navigation
IX. Power
X. Recreation
XI. Fish and Wildlife
XII. Flood Control
XIII. Water Quality Control
XIV. Watershed Management
XV. Plan Formulation

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ECONOMIC ENVIRONMENT

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EXHIBIT A—PROJECTED AGRICULTURAL ECONOMY

EXHIBIT B—PROSPECTIVE TIMBER SUPPLIES AND FOREST INDUSTRIAL DEVELOPMENT

EXHIBIT C—ECONOMIC ASPECTS OF THE MINERAL INDUSTRY

EXHIBIT D—ECONOMIC STUDY OF THE PUGET SOUND AND AJACENT WATERS AREA

FIGURE 1—1 Puget Sound Study Area and Economic Divisions

PHOTO 1. Downtown Seattle on an early spring day. Mount Rainier is approximately 60 air miles from Seattle and rises to an elevation of 14,410 feet. The building under construction is a 50-story office building which was completed in 1969. Seattle Times Photo.

INTRODUCTION

The Puget Sound and Adjacent Waters Area has an expanding economy in an attractive environmental setting of inland waters surrounded by forests and mountains. Water resource use and development for such purposes as municipal-industry water supply, irrigation, navigation and hydroelectric power, relates directly to the number of inhabitants and their activities. An understanding of the base for present and future economic activity is essential for comprehensive water resource planning.

The purpose of this appendix is to provide data and information on economic activities within the Puget Sound Area and to project the economy for the years 1980, 2000 and 2020. Utilizing studies made by the Consulting Services Corporation, the Economic Research Service and Forest Service of the U.S. Department of Agriculture, and the Bureau of Mines of the U.S. Department of Interior, and other sources, historical trends and economic activities were developed to a 1963 base and projections made for 1980, 2000 and 2020 recognizing the natural resources of the Area and factors influencing its competitive advantages. In addition to application for comprehensive water resource planning, the results of the study can be used for other planning purposes by area planning groups, governmental agencies of Federal, State and local levels, and by other public and private organizations.

Information and projections contained in the appendix pertain to such economic indicators as population, employment, output, and value added. In addition, the natural resource elements of agriculture, forests, and minerals are inventoried and projected. The summary report on the economic environment is based on the following special studies which are appended as exhibits.

Exhibit	Prepared by
A. *Agricultural Economy of the* Puget Sound and Adjacent Waters Area, Projections 1980, 2000 and 2020, September 1967	Economic Research Service U. S. Department of Agriculture
B. Prospective Timber Supplies and Forest Industrial Development in Puget Sound and Adjacent Waters Area, December 1968	Pacific Northwest Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture
C. Economic Aspects of the Mineral Industry in the Puget Sound and Adjacent Waters Area, July 1966	Bureau of Mines U.S. Department of the Interior
D. An Economic Study of Puget Sound and Adjacent Waters, Projections 1980, 2000 and 2020, January 1968	Consulting Services Corporation, Seattle

The Comprehensive Study of Puget Sound and Adjacent Waters covers the area formed by the hydrologic boundaries of streams flowing into Puget Sound, Hood Canal and the Straits of Georgia and Juan de Fuca as shown on Figure 1-1. This hydrologic area was used for studies by the Forest Service, U.S. Department of Agriculture (Exhibit B) and the Bureau of Mines, U.S. Department of Interior (Exhibit C).

In the investigation by Consulting Services Corporation (Exhibit D) and by Economic Research Service, U.S. Department of Agriculture (Exhibit A), the hydrologic area was expanded to whole counties as outlined in Figure 1-1 as tabulated below:

North	Central	West
Whatcom	Snohomish	Clallam
Skagit	King	Jefferson
Island	Kitsap	Mason
San Juan	Pierce	Thurston

This expansion was necessary to conform with availability of essential economic data. The economic activity in the additional land area is nominal due to the sparse population and large Federal land holdings, therefore the findings are considered to be representative of the smaller hydrologic area.

The 13,367 square mile[1] area formed by the hydrological boundaries is defined as the "Puget Sound Area." For economic study purposes, the Puget Sound Area has has been expanded to 15,784 square miles[2] covering twelve whole counties and is defined as the Puget Sound "Economic Area."

1 Land and inland lakes, rivers and stream areas, Appendix III, Hydrology and Natural Environment.

2 Land and inland lakes, rivers and streams, County and City Data Book, U.S. Department of Commerce 1967.

SUMMARY

DESCRIPTION OF AREA

PHYSICAL ENVIRONMENT

The Puget Sound Area lies in the northwest corner of the State of Washington, between the Cascade and Olympic Mountains with near sea level lowlands forming a trough about 50 miles wide as shown on Figure 1-1. Its 13,367 square miles of land, lying in a setting of forests and mountains has a terrain varying from barren glacier covered peaks through forest covered slopes to fertile farmlands and urban centers on river deltas and shore lands. In addition there are about 2,500 square miles of nearly landlocked salt water that have 10 major ports with deep water access to the Pacific Ocean. Twenty rivers flow into Puget Sound and its adjacent waters.

In the Cascade Range to the east, the higher ridges generally reach an altitude of 8,000 feet in the north and 5,000 feet in the south. Rising prominently above this ridge line are Mount Baker (10,778 feet); Glacier Peak (10,541 feet); and Mount Rainier (14,410 feet). The Olympic Mountain Range to the west is generally lower in altitude than the Cascade Range. The sharp peaks and ridges that characterize this mountain range reach altitudes of about 8,000 feet. These mountain ranges act as a barrier for the Puget Sound from cold Arctic and continental air and ocean storms during the winter. They also moderate the flow of cool, moist, and maritime air entering from the west and northwest during the summer months.

Mean annual precipitation varies from less than 20 inches in the lowlands of the Elwha-Dungeness Basins to 180 inches along the upper reaches of the Cascade Mountains. Seventy-five percent of the precipitation occurs in the 6-month period, October through March, with winter precipitation falling as rain below 1,500 and 2,500 feet, and as snow at the higher altitudes. Although temperatures have been recorded as high as 95°F to 100°F in the lower valleys, high temperatures usually range from 85°F to 90°F 5 to 15 days per year. Mean temperatures range from 65°F during the summer to 35°F to 40°F during the winter.

The rivers of the Puget Sound Area vary from a few miles to 135 miles in length. Glaciers, located at the higher elevations are the source for many of these streams, extending stabilizing influences on summertime low flows. The upper portions of most basins are characterized by narrow mountain valleys and streams having steep gradients which drain forested areas. In the lowlands, rivers follow meandering courses across the flood plains. The total runoff for the Puget Sound Area during the period 1931-1960 averaged about 38,865,000 acre-feet per year. Average annual runoff ranges from 15 inches in some of the northern lowlands to as much as 140 inches in a few mountain areas. Additional climatic and hydrological data are given in Appendix III, Hydrology and Natural Environment.

LAND USE AND TRANSPORTATION

Land Use and Ownership

The present pattern of land use ranges from areas with intense residential, commercial, and industrial concentrations to undeveloped cut-over lands and areas of second-growth timber. A general land use picture is shown on Figure 1-2 and Table 1-1.

Forest land predominates and accounts for 82 percent of the total land use. The area contains seven million acres of forests, most of which are capable of producing a timber crop of commercial quality. About 52 percent of the forest land area is in Federal ownership, and the remainder is held in State and private ownership.

There are over 591,000 acres of cropland in[1] the Puget Sound Area which is about six percent of the total land area. Agricultural operations are confined largely to the wide, fertile lowlands which are mostly utilized for hay and pasture as well as for fruit, berry, and vegetable growing and poultry raising operations. Cropland is well established in the river

[1] Estimated by Economic Research Service from Census of Agriculture data.

PHOTO 2. View from the Stevens Pass Highway with Mount Baring and Mount Grotto of the Cascade Range in the background. The Cascade Mountain Range forms the eastern boundary of the Puget Sound Area and contains some of the most unique glaciers in the United States. Public lands such as the North Cascade National Park, Glacier Peak Wilderness Area, and Mount Rainier National Park are in the Cascade Range. Seattle Times Photo.

valleys of the Nooksack, Puyallup, Green and Sammamish, Skagit and Elwha-Dungeness basins. Croplands are not extensive in the area, but the resulting production from them is very important to the general economy.

Urban buildup accounts for 5 percent of total land use of the area. Most urban development to date is found adjacent to the shores of Puget Sound and in the lowlands. Heavy industry is concentrated along the shores of Commencement Bay and Elliott Bay, on the tideflats near the mouth of the Puyallup River, and in the lower Duwamish River area. Developed lands are concentrated in the Central Division where the Seattle-Tacoma-Everett metropolitan and industrial complex and numerous small cities and suburban residential areas comprise approximately two-thirds of the area's total urban land use. Inland waters—streams and lakes—make up about two percent of the total land use. The fresh waters are utilized for outdoor recreation; anadromous and resident fish spawning, and rearing, hunting and fishing, various types of industrial operations, and domestic water

TABLE 1-1. Puget Sound Area. Present land use and ownership (acres in thousands)

River Basin		1968 Land Ownership[1]					1965 Land Use [2]						
		Federal	State	County and City	Private	Total	Cropland[3]	Range Land[3]	Forest	Rural Non-Farm	Urban Build-Up	Fresh Water	Total
Nooksack-Sumas	Acres	277	87	7	437	808	137	12	609	13	21	12	804
	% Basin	3.2	1.0	0.1	5.1	9.4	1.6	0.1	7.1	0.1	0.2	0.1	9.4
Skagit-Samish	Acres	1,378	107	8	433	1,936	100	20	1,754	20	19	35	1,948
	% Basin	16.1	1.2	0.1	5.2	22.5	1.2	0.2	20.5	0.2	0.2	0.4	22.7
Stillaguamish	Acres	178	72	2	190	442	35	1	384	6	7	5	438
	% Basins	2.1	0.8	0.0	2.2	5.2	0.4	0.0	4.5	0.1	0.1	0.1	5.1
Whidbey-Camano Is.	Acres	8	6	1	134	134	72	2	1,055	29	36	24	1,218
	% Basin	0.1	0.1	0.0	1.4	1.6	0.8	0.0	12.3	0.3	0.4	0.3	14.2
Snohomish	Acres	430	142	56	588	1,216	53	3	447	34	167	39	743
	% Basin	5.0	1.7	0.7	6.9	14.2	0.6	0.0	0.0	5.2	0.4	1.9	8.7
Cedar-Green	Acres	76	24	116	520	736	37	6	593	26	97	11	770
	% Basin	0.9	0.3	1.4	6.1	8.6	0.4	0.1	6.9	0.3	1.1	0.1	9.0
Puyallup	Acres	307	19	13	439	779	45	443	508	20	20	10	645
	% Basin	3.5	0.2	0.2	5.1	9.1	0.5	0.5	5.9	0.2	0.2	0.1	7.5
Nisqually-Deschutes	Acres	135	64	5	447	650	46	5	1,124	64	42	13	1,294
	% Basin	1.6	0.7	0.1	5.2	7.6	0.5	0.1	13.1	0.8	0.5	0.1	15.1
West Sound	Acres	368	122	20	782	1,291	24	2	409	5	5	6	448
	% Basin	4.3	1.4	0.2	9.2	15.1	0.3	0.0	4.7	0.1	0.1	0.1	5.2
Elwha-Dungeness	Acres	332	27	2	80	442	23	2	85	12	11	1	134
	% Basin	3.9	0.3	0.0	0.9	5.2	0.3	0.0	1.0	0.1	0.1	0.0	1.6
San Juan	Acres	1	9	1	101	113	19	9	72	9	3	1	113
	% Basin	0.0	0.1	0.0	1.2	1.3	0.2	0.1	0.8	0.1	0.0	0.0	1.3
Total	Acres	3,490	679	232	4,147	8,547	5 91	105	7,040	238	428	153	8,555
	% Basin	40.8	8.0	2.7	48.4	100.0	6.9	1.2	82.2	2.9	5.0	1.8	100.0

[1] U.S. Forest Service and the Washington State Department of Natural Resources, Appendix V, Water Related Land Resources.

[2] USDA Soil Conservation Service, Appendix V, Water Related Land Resources.

[3] Definition of agricultural land use categories, total stands, area and source of basic data differs from Exhibit A by Economic Research Service.

supply. The present pattern of land ownership in the area is 41 percent Federal, 11 percent State and local, and 48 percent private. Most of the federally-owned lands lie in the national forests and national parks.[1]

The major centers of urban population of the Central Division, located in the lowlands along the east shore of Puget Sound are Seattle (580,000),[2] Tacoma (156,000) and Everett (52,000). In the Central Division along the west shore of Puget Sound, the largest city is Bremerton (36,900). The most important urban center in the North Division is the city of Bellingham (36,500). The cities of Port Angeles (15,800) and Olympia (20,900) are the urban centers in the West Division.

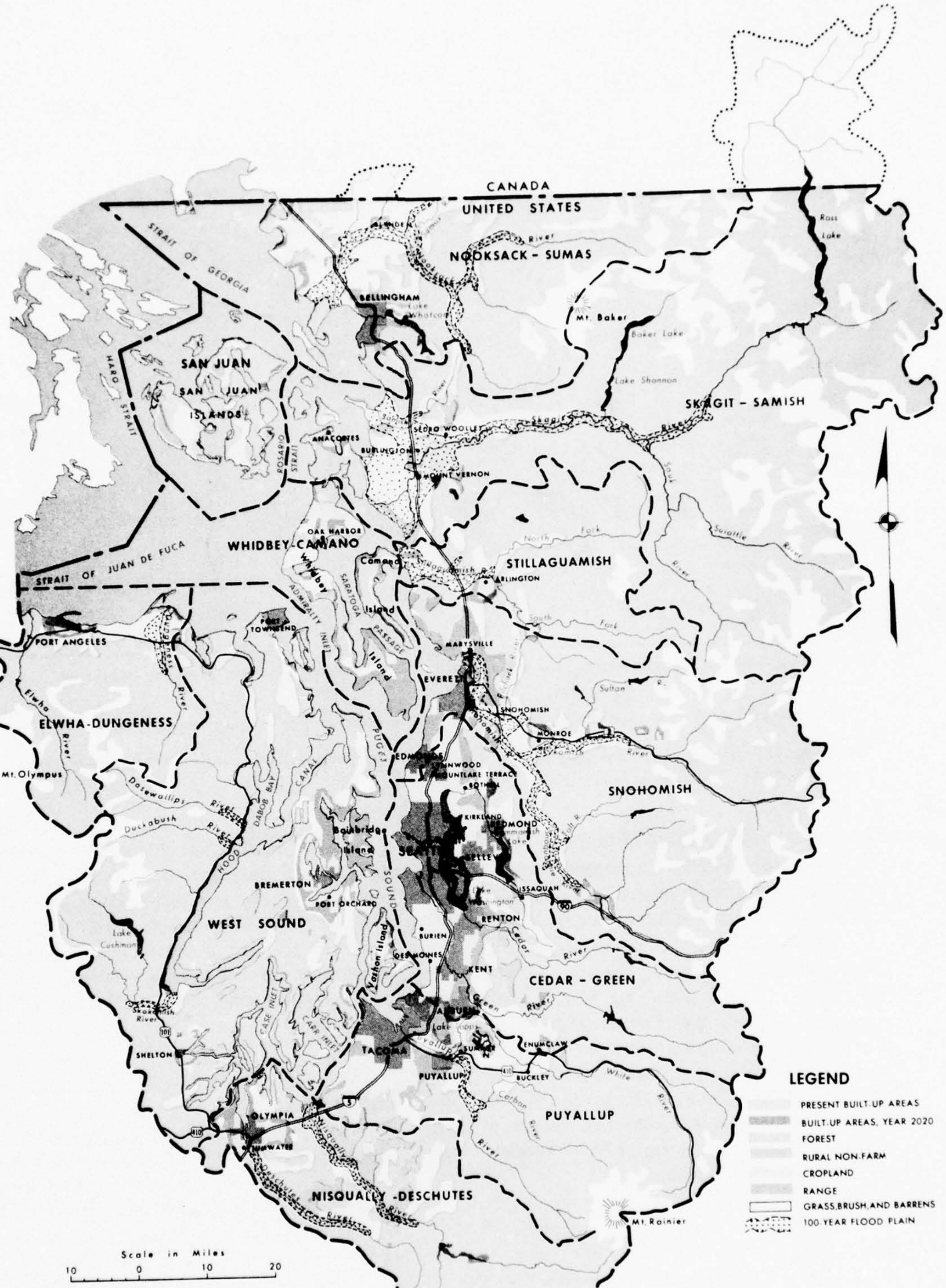
[1] Appendix V. Water Related Land Resources.

[2] 1967 estimated population. Planning and Community Affairs Agency, State of Washington.

As of 1967 the combined population of Seattle and Tacoma represent about one-third of the total population of the area, and when suburban areas are included their share increases significantly. As these cities and the city of Everett continue to expand, a single urban area will develop extending from Tacoma on the south through Seattle to the city of Everett on the north.

Transportation

The Puget Sound Area is served by all forms of transportation. Figure 1-3 shows the principal transportation routes. The area is served by four major transcontinental railroads: Northern Pacific, Milwaukee Road, Great Northern and Union Pacific. All of these lines offer direct routings and expedited service between Seattle and Chicago, Minneapolis, St. Paul, Omaha, Kansas City, St. Louis, Denver and east coast cities. Three rail lines have connections with the



PUGET SOUND AND ADJACENT WATERS STUDY AREA

Generalized Land Use

FIGURE 1-2

Canadian lines to the north, and three lines have connections to the Portland-Vancouver area and thence to the south and east. Two lines have connections to the Grays Harbor area and one has a branch line to Bremerton. A line from Port Townsend to Port Angeles is served by rail-barge connection.

The Puget Sound area has numerous modern freeways, highways and roads. The principal north-south artery is Interstate 5. Highways crossing the Cascade Mountains include U.S. Routes 2, 10 and 410. The western portions of the Puget Sound Area, on the Olympic Peninsula, are served by U.S. Route 101. Over 150 truck lines provide common carrier, and contract specialized transport.

The largest airport for both passenger and cargo traffic is the Seattle-Tacoma Internation Airport, and in addition a number of smaller airports in various communities of Puget Sound. Domestic service is provided by seven major airlines. Service to Alaska is provided by four airlines. There are two trans pacific airlines and two lines provide direct service to Europe over the arctic routes.

A complex of deep water ports now serve the region. Figure 1-4 shows the location of major ports and gives information on the controlling depth at the harbor entrance, and facilities available at the ports. The valuation of waterfront facilities of these ports is approximately $100 million on a depreciated basis. Total capital improvements over the past five years approximate $20 million. The controlling depth at the harbor entrances at most ports is practically unlimited, while at waterways and at berths along docks, the controlling depth varies from 25 to 70 feet. These ports are among the few natural harbors of the world which can handle "super bulk carriers," such as the "Manhattan" which has a draft of 51 feet fully loaded.[1]

Ports of the Puget Sound area have the full range of facilities required to handle both bulk and general cargo efficiently, including containerization facilities, backup areas and facilities for handling container bulk cargo. Many of the ports provide small boat moorage facilities for recreation boating and accommodations for commercial fishing fleets. In 1966, 186,000 pleasure boats were owned by residents of the Puget Sound Area. Sixty-two thousand of these boats were registered by the U.S. Coast Guard.[1] Recreation craft create large demands for small boat facilities.

The total waterborne commerce for years 1952 through 1966 is shown below in Tables 1-2 and 1-3 and has had a significant impact on the region's

[1] Appendix VIII, Navigation.

TABLE 1-2. Puget Sound Area. External Waterborne Commerce,[1] Puget Sound Ports, 1952-1966 (short tons)

Year	General Cargo	Bulk Grain	Forest Products	Bulk Petroleum	Other Dry Bulk	Other Liquid Bulk	Totals
1952	1,578,302	961,890	903,461	5,963,662	1,687,216	73,124	11,167,655
1953	1,646,865	711,089	1,072,749	5,614,860	1,483,788	100,689	10,630,040
1954	1,798,232	562,084	1,038,914	5,546,178	1,599,813	108,840	10,654,061
1955	1,610,642	876,239	880,404	5,929,032	1,973,423	115,920	11,385,660
1956	1,824,730	1,538,379	759,672	6,899,262	2,270,870	105,235	13,398,148
1957	1,715,473	1,898,289	922,321	5,641,121	2,402,945	118,836	12,698,985
1958	1,675,942	1,092,867	1,126,659	7,227,017	2,092,709	102,882	13,318,076
1959	1,788,756	995,036	1,196,765	9,211,647	2,227,277	124,131	15,543,612
1960	1,805,338	1,694,324	1,159,155	10,114,641	2,426,681	89,158	17,289,297
1961	1,682,022	1,474,922	1,289,218	8,474,480	2,427,073	125,163	15,472,878
1962	1,608,577	971,963	1,213,854	7,511,765	2,414,623	137,110	13,857,892
1963	1,852,765	1,205,977	1,902,562	7,944,703	2,831,702	155,625	15,893,335
1964	1,918,662	1,011,578	2,930,419	8,050,933	2,884,344	119,492	15,915,428
1965	2,081,687	1,296,205	2,205,993	8,774,446	2,707,276	132,583	17,198,190
1966	2,473,884	1,394,620	2,693,355	7,565,122	2,853,171	153,069	17,133,221

[1] Includes foreign imports and exports and domestic coastwise receipts and shipments.

Source: Part 4, Waterborne Commerce of the United States, U.S. Dept. of Army 1952-1966.

economy. In the period 1952-1966 movement of bulk petroleum was the most predominent commodity. This consisted mostly of domestic coastwise receipts of fuel oil. In 1964, 48,000 persons were employed directly, or were engaged in work dependent on waterborne commerce. The total estimated direct value of goods, services, payroll and sales, related to waterborne commerce, amounted to $1.1 billion.[1]

Commerce between and locally within Puget Sound Ports in the period 1952 to 1966 consisted mostly of forest products, bulk petroleum and dry bulk cargo such as sand, gravel and crushed rock as shown in Table 1-3.

The ferry system operated by the State of Washington connects the eastern shore of Puget Sound with the many islands, Olympic Peninsula and Vancouver Island, B.C. The ferry routes are shown on Figure 1-3. The State had 22 ferries (including four new super ferries) in operation in 1968. The total depreciated replacement cost was estimated at $62,214,560 in 1968. The total revenue for Fiscal Year ending 1968 was $12,866,500. In 1968, total ferry use included 4,800,000 vehicles and 11,600,000 passengers.[2]

[1] Appendix VIII, Navigation .

[2] Annual Report, Washington State Ferry System, 1968-69

TABLE 1-3. Puget Sound Area. Internal Waterborne Commerce,[1] Puget Sound Ports, 1952-1966 (short tons)

Year	General Cargo	Bulk Grain	Forest Products	Bulk Petroleum	Other Dry Bulk	Other Liquid Bulk	Totals
1952	741,350	370	12,456,166	2,317,927	4,499,107	11,888	20,026,808
1953	750,536	370	12,168,990	2,315,564	4,529,166	737	19,765,363
1954	889,591	195	9,936,410	2,638,282	4,596,440	678	18,061,596
1955	981,778	313,187	11,950,457	4,277,222	5,045,101	2,873	22,570,618
1956	1,317,847	112,162	11,690,906	4,658,061	4,636,696	44,481	22,460,153
1957	1,240,775	681,852	9,803,444	5,795,540	6,892,598	75,355	24,489,564
1958	746,653	27,970	8,329,079	6,761,054	5,575,541	54,663	21,494,960
1959	864,136	98,452	10,338,425	6,432,017	9,636,374	52,829	27,422,233
1960	807,669	0	9,234,505	6,967,768	8,464,719	68,258	25,542,919
1961	829,853	0	7,430,556	7,738,869	6,965,202	72,688	23,037,168
1962	928,192	0	8,042,253	8,380,959	8,339,167	33,291	25,723,862
1963	1,161,169	0	5,928,082	8,107,281	8,169,962	22,202	23,388,696
1964	1,145,352	0	6,917,947	9,807,107	7,100,458	31,947	25,002,811
1965	813,722	0	6,387,129	8,779,087	9,429,666	47,556	25,457,160
1966	1,010,482	0	7,407,257	6,319,683	9,816,498	27,809	24,581,729

[1] Includes domestic local and internal receipts and shipments in Puget Sound, Juan de Fuca Strait and Contiguous rivers and lakes.

Source: Part 4, Waterbo:ne Commerce of the United States, U.S. Dept. of Army, 1952-1966.

FIGURE 1-3. Transportation facilities in the Puget Sound Area

Major Ports of Puget Sound

No.	Major Ports of Puget Sound	Controlling Depth at Harbor Entrance (feet)	No. of Berths–1966 General Cargo	Commercial Fish	Bulk Grain	Forest Products	Bulk Petroleum	Other Dry Bulk	Other Liquid Bulk
1.	Bellingham	Unlimited	7	15	--	9	11	5	1
2.	Anacortes	50	4	14	--	3	11	1	--
3.	Everett	Unlimited	11	2	--	26	7	2	2
4.	Seattle	Unlimited	45	17	2	32	52	35	5
5.	Tacoma	Unlimited	15	1	2	29	11	14	2
6.	Olympia	40	5	--	--	17	5	2	--
7.	Port Angeles	Unlimited	7	4	--	4	3	4	1

FIGURE 1-4.

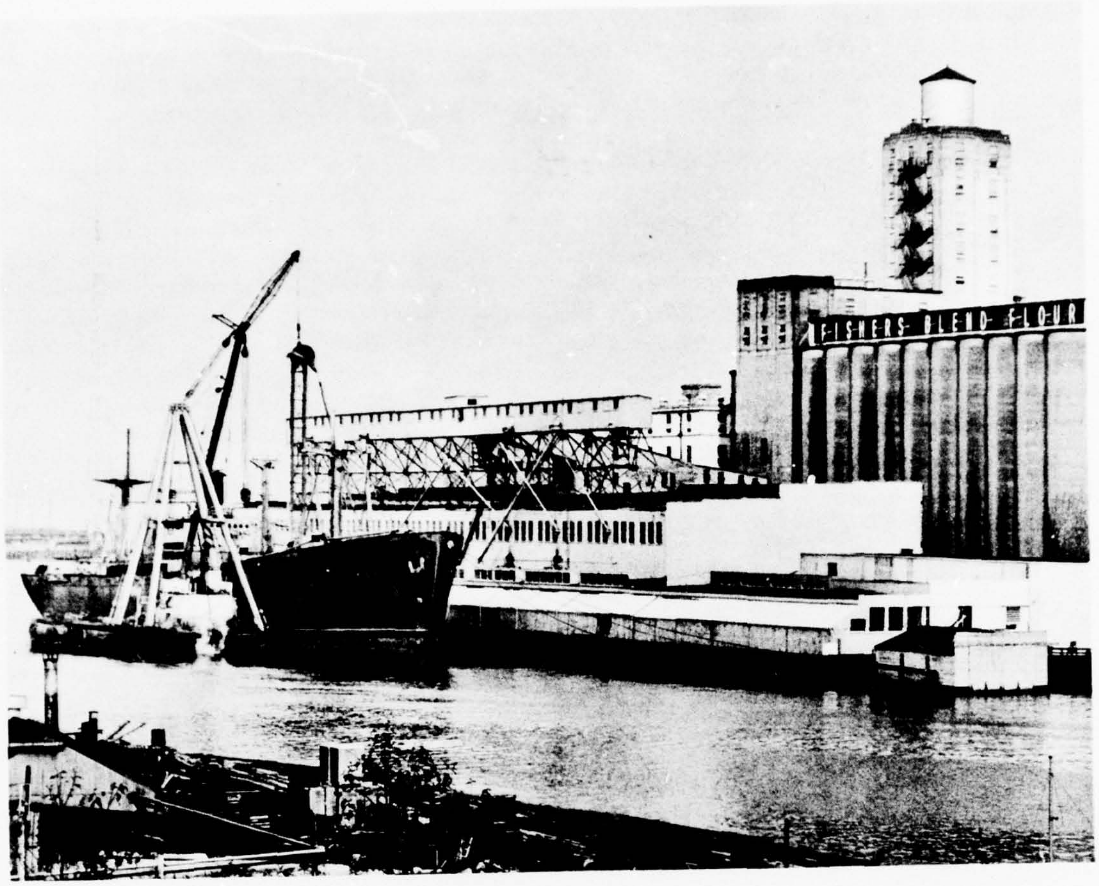


PHOTO 3. Puget Sound shipping. Ports in the Puget Sound Area have a full range of facilities to handle both bulk and general cargo. In 1964 approximately 41 million tons of external and internal waterborne commerce were shipped through these facilities providing a value of about $1.1 billion in goods, services, payrolls and sales. Seattle Times Photo.

RESOURCES

General

The Puget Sound Area has varied natural resources, the primary resource being the vast timber reserves. When early settlers founded the first communities the land areas surrounding the Sound were almost completely covered with dense stands of timber. The vast amount of valuable timber resources easily available for logging and milling, due to the proximity of the timber to water areas, led to settlement of the Puget Sound Area before most of the Pacific Northwest. As the population grew, agriculture, minerals, fisheries and environmental resources became important to the economic base. These natural resources are briefly summarized in the next few paragraphs. The reader is referred to other appendices of the Comprehensive Study for details.

Agriculture

Land in agricultural use and the number of farms of the Puget Sound Economic Area has declined sharply in the last twenty years due primarily to the encroachment of urban areas,[1] agricultural land declined 23 percent between 1950 and 1963 while the number of farms declined at an even faster rate. In 1963, 775,000 acres produced the entire farm output of the Puget Sound Area.[2] The area most vulnerable to change in land use is adjacent to the Everett-Seattle-Tacoma metropolitan area. The following tabulates acreage of land in farms in 1963:

TABLE 1-4. Puget Sound Economic Area. Land in farms 1963 (Acres) Division

Farm Land Use	Northern	Central	Western	Total
Cropland	238,250	162,750	85,000	486,000
Pastureland	72,600	125,600	90,800	289,000
Woodland	61,900	90,200	69,400	221,500
Other Land	21,000	24,200	11,800	57,000
Total	393,750	402,750	257,000	1,053,500

Source: Estimated from Census of Agriculture by Economic Research Service, U.S. Department of Agriculture.

The gross value of output of the agricultural economy was approximately $245,000,000 in 1963. Farm production provided a gross output of $135,000,000, of which $95,000,000 was sold to processing industries, $5,000,000 was utilized in[2] producing farm output, and $35,000,000 was consumed as final product.[3]

Forests

Timber resources of the Puget Sound Area were important to the historical economic growth and have been extensively utilized. During the early 1900's the stands of timber easily accessible to water transportation and at low elevations were heavily cut. At the present time the forest areas at low elevations are stocked with young-growth timber. At the higher elevations, expecially in the Cascade and Olympic Ranges, forest stands consist mainly of uncut, old-growth timber. Forest lands in the Puget Sound Area are used for a variety of purposes including timber, water, forage, fish and wildlife production was well as for homesites and recreation. Both public and privately-owned forest lands are extensively for scenic open space and recreation by people living in the urban areas of Seattle, Everett, and Tacoma. In addition, thousands of acres, previously in forest have been cleared for agriculture and urban-industrial development. As a result, the land area devoted to timber production—commercial forest land—has steadily decreased during recent years. Exhibit B by the Forest Service, U.S. Department of Agriculture is based upon a forest resource base as of 1968.[3]

Private owners hold about 57 percent of the commercial forest land, the remaining 43 percent is managed by Federal, State and local agencies. About 60 percent of the lands in public ownership are held in national forest.

Land area and classification by type of forest lands as of 1968 is shown in the following Table 1-5.

TABLE 1-5. Puget Sound Area. Forest land area by Class, December 1968, (in thousands of acres)

Division	Total Forest Land	Forest Land: Commercial	Forest Land: Unproductive	Forest Land: Productive Reserved
North	1,991	1,456	346	189
Central	3,164	2,635	337	192
West	1,274	913	183	178
Total	6,429	5,004	866	559

Source: Exhibit B, Table 4

Sawtimber inventory in the water resource study area indicates that most of the present volume is located on national forest lands due to the early liquidation of old growth on private lands. Consequently, privately-owned forests, which account for over half of the commercial forest land in the Puget Sound Area, hold only about one-third of the sawtimber inventory. The number of acres in the Puget Sound Area as of 1968 by commercial forest type is shown in Table 1-6.

[1] The number of farms in discussed in Exhibit A. Definition of land use categories, total Study Area and source of basic information differs from agricultural land use as discussed in Appendix V, Water Related Land Resources.

[2] Economic Research Service, U.S. Department of Agriculture.

[3] This base takes into consideration the forest areas of the Cascade Mountains which were converted to National Park and National Recreation Area Status under provision of Public Law 90-544 enacted in 1968.

TABLE 1-6. Puget Sound Area, Forest land area by commercial forest type, December 1968 (Thousands of acres)

Division	Total	Stand-size class: Saw-timber	Pole-timber	Samplings and Seedlings	Non-stocked
North	1,456	863	412	155	26
Central	2,635	1,526	782	294	33
West	913	341	384	177	11
Total	5,004	2,730	1,578	626	70

Source: Exhibit B, Table 6.

Minerals

During 1964, the area that drains into Puget Sound accounted for about 44 percent of Washington's mineral production. King, Pierce, Skagit, Snohomish, and Whatcom were, and still are, the leading counties in terms of quantity and value of minerals produced. Total production value from the whole area was $35.6 million in 1964.

The Puget Sound Area is particularly rich in reserves of nonmetallic minerals. Sand, gravel, clay, cement, and stone are produced in quantity for the construction industry. The largest olivine deposit in the United States is located in the area and is currently being mined by several operators. Olivine is crushed and ground and marketed principally for use as foundry sand to consumers in Western and Midwestern States and Canada. All of the talc production of the State of Washington and almost all of the peat production comes from the area. Limestone for use in making cement and lime, and for use as a soil conditioner is plentiful and the limestone used by the two largest cement plants in the State is quarried in the area. Other nonmetallic minerals that are now being mined, have been mined, or have the potential for production, are; strontianite, celestite, silica sand, quartz, alunite, and pozzolanic materials. Substantial reserves of most of these minerals are still available.

In the past, the area has produced considerable amounts of minerals that have yielded copper, gold, silver, manganese, antimony, arsenic, chrome, iron, lead, mercury, and zinc. During the past two decades production has declined, but with the constant change in requirements for metals brought on by rapidly changing technology, and with improved methods in extractive metallurgy and lower cost mining methods, the Puget Sound area holds promise as a future source of metallic minerals. The area contains several apparently large low-grade copper deposits that could produce copper, with molybdenum, silver, zinc, and gold as by-products.

No crude oil or natural gas is produced in the Puget Sound Area, but the area has a potential for future production. Within the Puget Sound Area there are unexplored areas that have structural and stratigraphic conditions favorable for the accumulation and storage of oil and gas.

Coal reserves in the Puget Sound Area are extensive but vary in quality and cost of mining. The important fields are in Cedar-Green, Puyallup and Nooksack basins.

In summary, the Puget Sound Area is richly endowed with mineral resources. Extensive coal, sand and gravel, clay, stone and peat deposits occur in the lowland areas. The mountainous area in the eastern part of the region has a large potential for producing metallic minerals, as well as stone and nonmetallic mineral products.

Water[1]

Freshwaters—The total runoff for the Puget Sound Area during the period of 1931-1960 averaged about 38,865,000 acre-feet per year. Average annual run-off ranges from 15 inches in some of the northern lowlands to as much as 140 inches in a few mountain areas. The major rivers, in terms of largest average annual runoff, are listed in Table 1-7 with discharge at recording stations.

[1] Appendix XIII, Water Quality Control.

TABLE 1-7. Puget Sound Area, Principal Rivers

Basin	River	Drainage Area Sq. Miles	Discharge (cfs) Min. Daily	Max. Daily	Average Annual
Nooksack-Sumas	Nooksack River nr. Lynden	648	595	46,200	3,699
Skagit-Samish	Skagit River nr. Mt. Vernon	3,093	2,740	144,000	16,490
Stillaguamish	South Fork, Stillaguamish River nr. Granite Falls	119	55	32,400	1,064
Snohomish	Snohomish River nr. Snohomish	1,714	[1]	136,000	9,500
Cedar-Green	Cedar River at Renton	186	56	6,640	711
Cedar-Green	Green River at Tukwila	440	195	12,100	1,462
Puyallup	Puyallup River at Puyallup	948	306	57,000	3,364
Nisqually-Deschutes	Nisqually at McKenna	517	20	25,700	1,415
Nisqually-Deschutes	Deschutes River nr. Rainier	90	16	5,620	263
West Sound	Skokomish River nr. Potlatch	227	125	27,000	1,188
Elwha-Dungeness	Elwha River nr. Port Angeles	269	10	41,600	1,487
Elwha-Dungeness	Dungeness River nr. Sequim	156	77	8,400	373

[1] Discharge less than 10,000 cfs. Not computed due to tidal influences.

Source: Appendix XIII, Water Quality Control.

The rivers in the Puget Sound Area have been a source of power and energy since the earliest days of settlement. As of 1968 about one and a quarter million kilowatts were installed on rivers and tributaries that flow into Puget Sound. Irrigation is generally supplemental to natural precipitation and is applied mostly by sprinklers during extended dry periods in the summer. If the summer is wetter than average, many farmers do not irrigate at all that season. Lakes and rivers are valuable recreation and fish and wildlife resources.

Heavy yields of ground water can be anticipated in the lower valley forest and adjacent to the delta of the rivers and tributaries in the area. Ground water yields are relatively small in the mountainous area of the region. Aquifers occur in recessional outwash, alluvial and gravel and sand deposit. These aquifers usually contain fresh water at depths as much as a few hundred feet below sea level except in nearshore areas where aquifers less than 200 feet deep may contain sea water. The aquifers that contain fresh water recharge from infiltration of precipitation principally during winter months.

PHOTO 4. Skykomish River—near Mount Index in the Snohomish River Basin. Runoff from all rivers and streams in the Puget Sound Area averages about 39 million acre-feet annually. Rivers in the Area have been a source of hydropower and irrigation since the earliest days of settlement. Seattle Times Photo.

Marine Waters—Marine waters comprise Puget Sound, Hood Canal and the Straits of Juan de Fuca and Georgia. The Straits of Juan de Fuca and the connecting channels provide natural deep water access for unrestricted vessel size and speed from the Pacific Ocean to the many bays and inlets of Puget Sound. The controlling depth at the entrance to Puget Sound is about 200 feet while Puget Sound has depths of over 900 feet. Puget Sound is protected from ocean waves and swells, but local storm waves can be generated in some reaches of the Sound up to a maximum of about 8 feet. With such natural advantages it has been possible to develop harbors and terminal facilities with a minimum of channel improvements .

These marine waters have high aesthetic values and are a base for the important recreation and fish and wildlife resource. These aspects are discussed in subsequent paragraphs.

Fisheries[1]

Puget Sound is unique in that it is the largest inland sea on the Pacific Coast containing some 2,167 statute miles of shoreline. Its waters are extremely rich and its environment widely varied. Many of the fish and shellfish that live in or migrate through Puget Sound waters are of significant value to commercial and sports fishermen and the economy of the region. The 1958-1965 average annual commercial harvest of all fish and shellfish in the Sound amounted to over 103 million pounds, and the average annual wholesale value amounted over $12,800,000. An estimated 300,000 sportsmen fished Puget Sound waters and its tributaries in 1965 for salmon, trout, and other

[1] Department of Fisheries, State of Washington.

PHOTO 5. Commercial fishing boats moored at a *Seattle pier. In 1965 the commercial fisheries of Puget* Sound produced approximately $13 million in value to the fishermen. Seattle Times Photo.

marine fishes. Crabs and clams are also enthusiastically sought by recreationists. The expenditures by Puget Sound saltwater fishermen are estimated to range from $50 to $60 million per year for bait, tackle, boats, and other fishing expenses.

The important shellfish inhabiting the Sound are oysters, crabs, hardshelled clams, octopus, squid, shrimp, and scallops. Total commercial shellfish harvest for 1961-1965 averaged six to seven million pounds annually with a value of over 1.2 million dollars to the fisherman.

The anadromous species of fish in Puget Sound include the chinook, silver, sockeye, pink, and chum species of salmon and the steelhead, searun cutthroat, and Dolly Varden trout. All of these fish spend 1 to 3 years of their life in the marine environment of Puget Sound and the Pacific Ocean before migrating to their home streams to spawn. The juveniles of these fish spend varying amounts of time in the estuary waters of the Sound before moving seaward on their feeding migration. Salmon are a valuable commercial as well as an important sport fish. In 1963, commercial fishermen took nearly seven million salmon, while sportsmen caught about 785,000. These Puget Sound origin salmon contribute heavily to the ocean sport and commercial catches and are also harvested by Oregon and Canadian fishermen.

The bottom fish of the Sound includes (by local and common name) rockfish, sole, flounder, ling cod, black cod, true cod, sharks, rays, skates, ratfish, perch, anchovy, candlefish, hake, herring, pilchard, smelt, turbot, and greenling. All of these fish are commercially harvested, either for their value as food fish or for their incorporation into such products as fertilizer, vitamins, mink food, fish food, and pet foods. The average annual commercial harvest of

these bottom fish is about 46 million pounds. Many of these species are also taken by the sports, fisherman. Resident freshwater species found in the lakes and streams include trout, char, spiny-ray, kokanee, plus numerous other fish. The anadromous trout and char species and significant populations of other freshwater game fish serve a leading role in the area's recreation potential, being utilized by many local sportsmen, out-of-state residents, and tourists.

TABLE 1-8. Puget Sound Area. Commercial fisheries value to fishermen (1965)

Halibut	$2,951,279
Salmon	5,412,147
Shellfish	1,244,592
Sole and Flounder	775,095
Black Cod	250,586
Rockfish	305,505
Ling Cod	260,451
True Cod	513,964
Other	806,246
Total	$13,237,279

Source: Department of Fisheries, State of Washington, 1965 Fisheries Statistical Report.

Environment

The Puget Sound Study Area is rich in environmental resources. Abundant scenic inland waterways with sheltered coves and sandy beaches, large crystal-clear rivers and lakes, extensive verdant forest lands and the rugged splendor of the Cascade and Olympic mountain ranges, provide an environment of natural beauty with many diversified opportunities for outdoor recreation. They make the study area an excellent place in which to live or visit, and they provide the recreationists and tourists with an abundance of leisure time opportunities. Recreation demand may increase six times between 1960 and the year 2020. The Study Area's environmental resources fall into four geographic categories, the Olympic Mountains, the shoreline fringe, Puget Sound, and the Cascade Mountains.

The Olympic Mountains are characterized by broken and eroded peaks, serrated ridges, alpine valleys, lakes and cascading streams. Within this area of outstanding scenic beauty, snow-covered mountains rise above dense forests of Douglas-fir and western hemlock. Above timberline, wildflowers are prolific in the mountain meadows of Olympic National Park.

The shoreline fringe includes many miles of saltwater shoreline which attract recreationists from the heavily populated Seattle-Tacoma-Everett area. Here, the rivers lose much of their velocity after leaving the mountains, building up broad deltas, sloughs and marshes where the Sound and rivers meet. Portions have been urbanized. In the less densely populated areas, forests alternate with pastures, farms, shore side bluffs, and beaches providing a peaceful scene for the sightseer.

More than 300 islands and nearly 2,500 square miles of interior salt water contribute to the Puget Sound environment. Along the shores of the islands, madronas and conifers rise above the rocks, white sand and gravelly beaches. From the water, the woods seem to be a leafy tangle, highlighted in the summer by the inflorescence of dogwood and currant. Numerbays that form a great part of the popular waters of Puget Sound welcome boaters.

As with the Olympic Mountains, the Cascades contain environmental attractions of national significance, the most notable being Mt. Rainier and the North Cascades National Parks. Numerous glaciers give rise to beautiful rivers which have cut deep narrow valleys on their way to the Sound. Many small lakes are found cradled among the majestic peaks. Throughout the Cascade Mountain area, wildflowers create a colorful display.

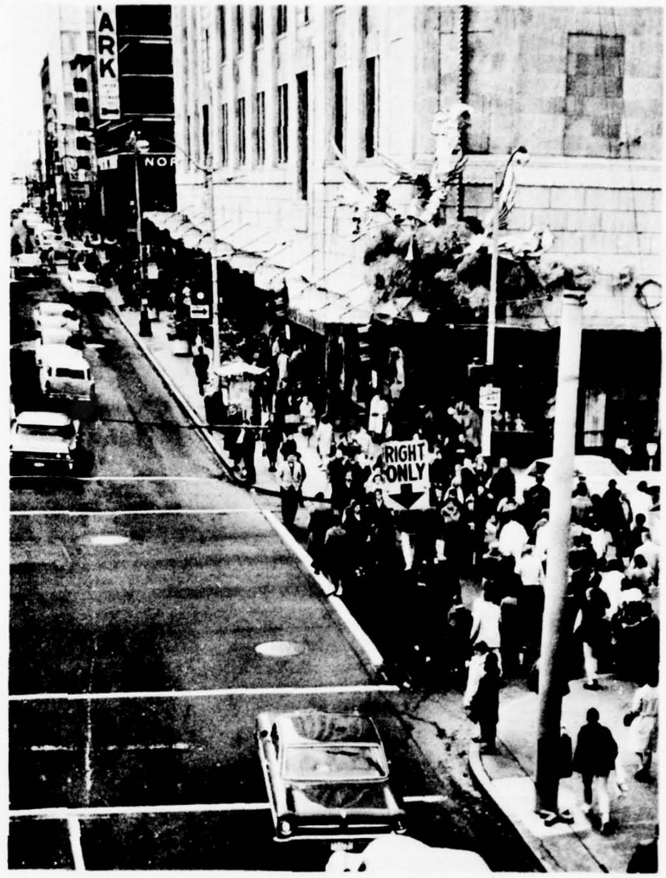
Numerous varities of fresh and saltwater game fish make sport fishing and important recreational activity. Undisputed king of the freshwater game fish is the steelhead trout which is also the most desired by fishermen.

The huge water area provides a vast playground for boating enthusiasts. Boaters troll for salmon in the Sound, sail and race on Lake Washington, and explore the islands of the San Juan archipelago. The number of pleasure boats per capita in the Puget Sound Area is among the highest in the Nation.

The total demand for water-related activities in the Area was 25 million recreation days in 1960. More than half of this recreational water use concentrated in four basins—Snohomish, Cedar-Green, West Sound, and Puyallup.[1]

[1] Appendix X, Recreation.

PHOTO 6. Downtown Seattle. In 1963 almost two-thirds of the population of the State of Washington was located in the Puget Sound economic area. Population growth in the Area in the period 1950-60 was attributable to both a natural increase of 16 percent and a net migration of 9 percent. According to the 1960 census, urban dwellers constitute approximately 75 percent of the total population. Seattle Times Photo.



PRESENT ECONOMY

POPULATION[1]

Historical Growth

By 1966, the Economic Area had over two and one-half decades of substantial growth. Beginning with a World War II (1940) population of about one million people, the Area grew to two million inhabitants—doubling in only 26 years. This rate of growth was twice the national increase, and 15 percent more than that of the State of Washington. The decade of the forties was one of the periods of greatest growth in the history of Puget Sound. Between 1940-50 the Area grew at an average annual rate of 3.5 percent. This was 2.5 times faster than the rate of national growth and slightly higher than that of the State of Washington. Of the three divisions, the Central Division led with an annual growth rate of 3.8 percent per year, compared with 2.2 percent for the Western Division and 1.5 percent in the Northern Division.

During the 1950-1960 period the growth rate had slowed to 2.2 percent per year as compared to the United States rate of 1.6 percent and the rate of 1.8 percent for the State of Washington. The Central Division continued to be the leading sector as the

[1] Based on data from the Bureau of the Census, U.S. Department of Commerce.

FIGURE 1-5. COMPARATIVE DISTRIBUTION OF POPULATION BY AGE AND SEX
Puget Sound and Adjacent Waters Economic Area
North Div., Central Div., West Div., and United States
1960

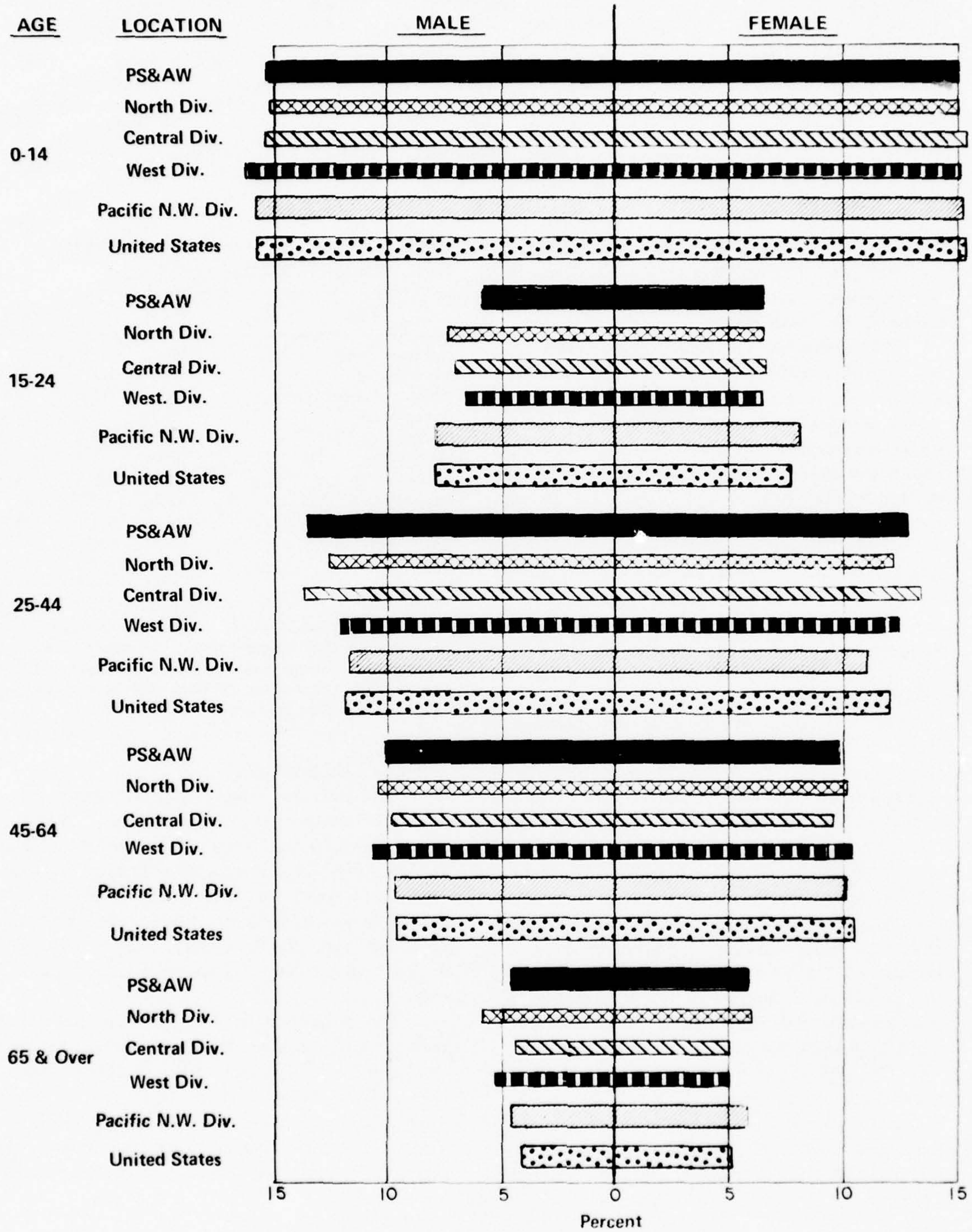


TABLE 1-9. **Population, United States, State of Washington and Puget Sound Economic Area (thousands)**

	1910	1940	1950	1960	1963	1966
United States	92,228	132,164	151,326	179,323	189,417	196,920
Washington	1,142	1,736	2,379	2,853	3,005	3,120
Puget Sound						
Economic Area	607	1,007	1,418	1,768	1,870	1,965
North Division	87	107	124	144	151	152
Central Division	482	820	1,196	1,513	1,603	1,694
West Division	38	80	98	111	116	119

Source: U.S. Department of Commerce; Washington State Department of Health, Public Health Statistics Section; and Consulting Services Corporation.

metropolitan population of Seattle grew rapidly. In the 1950-1960 decade the growth of the North and West Divisions failed to equal the modest growth shown by the United States.

The decade of the 1960's began rather ominously with curtailed employment in the aerospace industry due to reduced military orders. However, mainly as a result of a resurgence in commercial air frame construction, population growth accelerated. During the first five years, the Area grew at the same average annual rate as the nation, 1.4 percent. However, in one year (1965-66) the population grew 3.2 percent. Overall, from 1960 to 1966 the growth was 1.8 percent per year compared to 1.4 for the Nation and 1.5 for the State of Washington.

Table 1-9 is a comparison of the growth of population for the period for the United States, Washington, Puget Sound Economic Area and its three divisions.

In 1963 almost two-thirds of the population of the State of Washington was located in the Puget Sound Economic Area. Figure 1-2 shows the general land use of the Area and delineation of the Area into eleven major river basins. The Snohomish, Cedar-Green, and Puyallup Basins, which contain the urban centers of Everett, Seattle and Tacoma, account for approximately 80 percent of the total population. The Nisqually-Deschutes, West Sound and Elwha-Dungeness Basins contain 11 percent of the Area's population. The balance of less than 10 percent of the population is located in the Nooksack-Sumas, Skagit-Samish, San Juan Islands, Whidbey-Camano, and Stillaguamish Basins.

The highest population density is in the Cedar-Green Basins which contain the Seattle metropolitan area and consequently over half of the people of the Puget Sound Area. The following Table 1-10 shows the population by river basins for the years 1950, 1960 and 1963:

TABLE 1-10. Population by Basins, Puget Sound Area, 1950-1960-1963 (thousands)

Basin	1950	1960	1963
Nooksack-Sumas	66.7	70.3	74.6
Skagit-Samish	43.3	51.4	53.8
Whidbey-Camano Islands	11.1	19.6	19.9
Stillaguamish	10.3	16.0	17.6
Snohomish	117.2	162.2	178.2
Cedar-Green	723.0	923.9	976.6
Puyallup	264.6	308.4	324.5
Nisqually-Deschutes	48.6	59.3	69.6
West Sound	114.1	124.1	124.2
Elwha-Dungeness	26.4	30.0	28.3
San Juan Islands	3.2	2.9	2.6
Total	1,428.5	1,768.1	1,870.0

Source: Estimated disaggregation into basins based on country and division totals prepared by Bureau of the Census, U.S. Department of Commerce and Consulting Services Corporation (Exhibit D).

Age-Sex Composition

Age and sex composition are major determinants of the natural increase in population and of labor-force participation rates. The most meaningful age categories for purposes of this study are: children–0–14 years of age; young adults–15–25; parents of young children–25–44; middle-aged residents who typically do not have children at home–45–64; and retired residents–65 years of age and over.

The proportion of the population in 1960 in each age group was comparatively uniform between the Puget Sound Economic Area, the Pacific Northwest and the Nation as shown in Figure 1-5. In the Puget Sound Economic Area the age group 0–14 years is the largest, accounting for approximately 31 percent of the total population. The smallest is the 65

years and over category which comprises 10 percent of the population. Other age groups and proportion of population are 15–24, 13 percent; 25–44, 26 percent; and 45–64, 20 percent. Trends between 1950 and 1960 in the proportion of population in each age group were generally similar for the economic study and its three divisions.

Generally, within age groups the most important increase occurred in the 0–14 age group, whereas the 15–25 and 25–44 groups decreased or remained fairly stable. This difference in growth is the result of a high birth rate between 1945 and 1950 and a low birth rate between 1935 and 1940. In the 0–14 age group, males outnumber females in each of the divisions. This is not true of other age groups because of differences in sex mortality rates, and in age-sex *migration rates*. The following Table 1-11 compares the population distribution by age and sex for 1950 and 1960 in the economic study area and three divisions.

TABLE 1-11. Population distribution by age and sex, Puget Sound Economic Area (1950-1960)

Age Group	1950 Male	1950 Female	1950 Total	1960 Male	1960 Female	1960 Total
Puget Sound Economic Area						
0-14	180,851	174,996	355,847	276,304	267,008	543,312
15-24	110,776	88,922	199,698	122,462	115,242	237,704
25-44	221,535	215,498	437,033	233,849	231,861	465,710
45-64	151,585	144,639	296,224	175,120	174,047	349,167
65 & Over	65,130	64,490	129,620	80,447	91,777	172,224
Total	729,877	688,545	1,418,422	888,182	879,935	1,768,117
North Division						
0-14	16,769	16,388	33,157	22,177	21,463	43,640
15-24	8,498	7,973	16,471	10,177	9,447	20,029
25-44	17,018	17,004	34,022	16,839	17,230	34,069
45-64	13,609	13,135	26,744	14,899	14,598	29,497
65 & Over	7,319	6,617	13,936	8,250	8,692	16,942
Total	63,213	61,117	124,330	72,747	71,430	144,177
Central Division						
0-14	149,940	144,936	294,876	236,107	228,426	464,533
15-24	95,561	74,489	170,050	104,555	98,720	203,275
25-44	189,933	184,316	374,249	203,688	201,020	404,708
45-64	127,481	122,139	249,620	148,481	148,010	296,491
65 & Over	53,328	54,049	107,377	66,539	77,433	143,972
Total	616,243	579,929	1,196,172	759,370	753,609	1,512,979
West Division						
0-14	14,142	13,672	27,814	18,020	17,119	35,139
15-24	6,717	6,460	13,177	7,325	7,075	14,400
25-44	14,584	14,178	28,762	13,322	13,611	26,933
45-64	10,495	9,365	19,860	11,740	11,439	23,179
65 & Over	4,483	3,824	8,307	5,658	5,652	11,310
Total	50,421	47,499	97,920	56,065	54,896	110,961

Source: Census of Population, Bureau of the Census, U. S. Department of Commerce 1950 and 1960.

Migration[1]

The population growth is the result of natural increase (births minus deaths) as well as migration to the Area. Since 1940, both have played important roles in the expansion of the Area at various periods of time. The expansion of military bases and increases in wartime production of ships and aircraft where responsible for a large influx of migrants between 1940-1950. During this ten-year period, the population increased over 411,000 with nearly two-thirds attributable to migration. The Central Division absorbed 95 percent of the Area increase. Large numbers of young adults who characteristically have high fertility and low mortality rates predominated this westward migration. In the period between 1950 to 1960, growth due to natural increase predominated and represented about two-thirds of the total increase as shown in the following Table 1-12.

TABLE 1-12. Natural increase and net migration of population, Puget Sound Economic Area (1950-1960)

Division	1950-60 Net Change in Population	Total Natural Increase	Total Net Migration
North	19,843	16,537	3,310
Central	316,807	188,696	128,111
West	13,049	15,340	-2,299
Total	349,699	220,573	129,122

Rate of Natural Increase 15.5%
Rate of Net Migration 9.1%

No migration statistics are available for the Economic Area during the sixties but some estimates have been made for 1960-65 for the State of Washington. The State showed an increase in population of 186,000 with only 7,000 due to net migration. Over the next few years industrial growth and employment opportunities are expected to greatly increase the number of in-migrants. An annual net migration of about 80,000 people is expected during the coming years as workers move into the State of Washington to meet the employment demands.

Urban and Rural Population[1]

As of 1960, urban dwellers constituted approximately 75 percent of the total population of the Puget Sound Economic Area. In comparison, the United States is approximately 70 percent urban in character. The urban population of the Area increased by 34 percent in the 1950-1960 period in contrast with a 29 percent increase in urban population in the Nation. Most of the increase in urban population in both the Study Area and the Nation has taken place in the periphery of cities. This is due to suburbanization rather than the extension of city boundaries. In the Puget Sound Economic Area, there are two Standard Metropolitan Statistical Areas (SMSA) established by the Bureau of the Census, U.S. Department of Commerce: the Seattle-Everett SMSA is defined as King and Snohomish Counties and the Tacoma SMSA is defined as Pierce County.

The Central Division which contains both SMSAs was almost 80 percent urban in character in 1960 in contrast with the North and West Divisions which were less than 50 percent urban. However, the population of both these latter divisions is steadily becoming more urbanized as indicated on Table 1-13 which compares 1950 and 1960 urban and rural population by division and county.

[1] Based on data from Bonneville Power Administration, U.S. Department of Interior, Pacific Northwest Economic Base Study for Power Markets, Vol. II, Part I, Population.

TABLE 1-13. Urban and rural population, Puget Sound Economic Area, (1950-1960)

Division	1950 Urban	1950 Rural	1960 Urban	1960 Rural
North				
Whatcom	34,112	32,621	37,230	33,087
Skagit	15,448	27,825	23,008	28,342
Island	--	11,079	3,942	15,696
San Juan	--	3,245	--	2,872
Total	49,560	74,770	64,180	79,997
Percent of Total	39.9%	60.1%	44.5%	55.5%
Central				
Snohomish[1]	47,882	63,698	96,455	75,744
King[1]	636,623	96,369	837,319	97,695
Kitsap	30,708	45,016	40,313	43,863
Pierce[2]	183,198	92,678	233,687	87,903
Total	898,411	297,761	1,207,774	305,205
Percent of Total	75.1%	24.9%	79.8%	20.2%
West				
Clallam	11,233	15,163	12,653	17,369
Jefferson	6,888	4,730	5,074	4,565
Mason	5,045	9.977	5,651	10,600
Thurston	18,544	26,340	28,788	26,261
Total	41,710	56,210	52,166	58,795
Percent of Total	42.6%	57.4%	47.0%	53.0%
Total Puget Sound Economic Area	989,681	428,741	1,324,120	443,997
Percent of Total	69.8%	30.2%	74.9%	25.1%

[1] The Seattle-Everett Standard Metropolitan Statistical Area is defined as King and Snohomish Counties.

[2] The Tacoma Standard Metropolitan Statistical Area is defined as Pierce County.

Source: Bonneville Power Administration, U. S. Department of Interior, Pacific Northwest Economic Base Study for Power Markets, Vol. II, Part I, Appendix C, Page 52.

LABOR FORCE[1]

The proportion of the population 14 years and over entering the labor force increased in all divisions of the Puget Sound Economic Area, in Washington State and the Nation in the 1950-1960 period. However, the labor force has grown less rapidly than the population during the period because the portion of the population under 14 years of age has expanded rapidly. This is a result of the large increase in the number of children due to the postwar baby boom and partly because of the size of the working age population (14 years and over) reflects a trough in the population reflecting the low birth rates of the thirties. The following Table 1-14 compares participation rates for the 1950-1960 period:

TABLE 1-14. Washington and United States labor force participation rate population 14 years and over, Puget Sound Economic Area (1950-1960)

	14 Years and Over Percent of Population In Labor Force	
Division	1950	1960
North	48.7	52.6
Central	55.1	57.1
West	53.1	54.1
Total	54.7	56.5
State of Washington	54.0	56.1
United States	53.4	55.3

For the total Puget Sound Economic Area between 1950 and 1960 the male participation rate remained stable at around 80 percent in contrast to the female participation rate which jumped from 29 percent in 1950 to about 36 percent in 1960.

In the period 1950–1960 the total labor force of the Puget Sound Economic Area increased by 20.2 percent. During this period the male labor force increased by 11.6 percent and female workers increased by a remarkable 45.2 percent. For this reason, the sex composition of the working age population plays an important role in explaining why the participation rates differ in the three divisions. However, the differences in the change in female participation rates were largely attributable to the urban-rural composition of the female working age population.

EMPLOYMENT[1]

The rate of growth of industry and changing industrial composition are indicators of the dynamic aspects of the economy of an area. Many forces bring about these changes and the resultant impact on employment in an area is reflected in composite economic advantages relative to other areas. Relative employment trends in the Economic Study Area, therefore, indicate its comparative investment and development opportunities.

Two sources of industrial employment data suitable for comparative analysis are available. Employment data tabulated geographically by site of establishment at which the employee works is commonly referred to as "establishment data," whereas those which are assigned geographically to the residence of the employee are referred to as "household" data. U.S. Census data are considered as "household" data, whereas State departments of employment are "establishment." The two data types are not comparable in many respects. Although both data sources are used, most trends and comparative analyses are based on establishment data.

Since the growth and character of the national economy has a major influence on the development of the Puget Sound Economic Area, comparison of rates of growth between the two reveal the relative economic advantage of area industries. The character of the basins' economy and its changes, historically, will have a bearing on future development. Accordingly, employment trends in each of the various industries and the changing relationships among these categories serve as indicators of future employment levels.

In the twenty-year period 1940-1960, total employment in the United States increased at an average annual rate of 1.9 percent as compared with 2.9 percent for the Puget Sound Economic Area. The following Table 1-15 shows the comparison of the Area with the nation for important sectors of employment.

1 Based on data from Bureau of Census, U.S. Department of Commerce and Department of Employment Security, State of Washington.

TABLE 1-15. Comparative employment rates of growth, Puget Sound Economic Area and United States (1940-1960)

(Average Annual Percent)

Employment Sector	Puget Sound Economic Area	United States
Agriculture, Forestry Fishing and Mining	-2.2	-5.2
Construction	3.4	3.1
Manufacturing	3.5	2.6
Transportation, Communication & Public Utilities	2.1	1.8
Trade	2.6	2.2
Services	3.5	2.4
Finance, Insurance, Real Estate	3.6	3.1
Government	4.5	5.2

Source: Census of Population, Bureau of the Census, U.S. Department of Commerce.

In this twenty-year period, growth in the Puget Sound Economic Area exceeded that of the nation in all categories except government. In agriculture, forestry, fishery and mining the Area declined at a rate lower than that of the nation.

A more recent comparison is for the period 1960-1966 as shown below:

TABLE 1-16. Comparative employment rates of growth, Puget Sound Economic Area and United States (1960-1966)

(Average Annual Percent)

Employment Sector	Puget Sound Economic Area	United States
Agriculture, Forestry, Fishing and Mining	-2.1	-5.4
Construction	4.8	2.2
Manufacturing	4.4	2.1
Transportation, Communication & Public Utilities	2.3	0.5
Trade	3.1	2.5
Services	4.2	4.4
Finance, Insurance, Real Estate	3.8	2.4
Government	4.0	4.4

Source: Census of Population, Bureau of the Census, U.S. Department of Commerce, and Department of Employment Security, State of Washington.

In the six-year period (1960-1966) the average annual growth of employment of 3.7 percent, made the Puget Sound Economic Area one of the fastest growing areas in the United States. The national rate of growth during the period was 1.5 percent. The average annual growth rate in construction employment was more than double that of the nation and employment in transportation, communication and public utilities grew over four times faster than the national rate. The most significant upward trend has been in the category of "other durable manufacturing" which includes aerospace and shipbuilding. In Table 1-17 this category of employment has increased at an average annual rate of 6.9 percent (78,700 to 117,500) for the six-year period. The second largest annual rate of growth was experienced by the primary metals industry, followed by construction in third place. Rates of growth in service, government and trade employment follow in fourth, fifth and sixth place, respectively, but the magnitude of the number employed is highly significant. In 1960 and 1966 these three categories represented about 59 percent of total employment.

The dominance of the Everett, Seattle and Tacoma metropolitan areas of the Central Division is outstanding in the pattern of economic growth and development of the Puget Sound Economic Area. In 1966, the Central Division accounted for 88 percent (680,300) of all employment in the area. The "other durable manufacturing" sector (including aerospace and shipbuilding) was 99 percent for the Central Division and one percent for both the North and West Divisions. The Central Division predominated in most all other sectors and was less important in agriculture, forestry, fishing and mining (56 percent), forest product industries (66 percent) and petroleum refining (17 percent) which reflects the urban character of the Central Division.

As of 1966, the North Division had a total employment of 51,100 of which 54 percent was employed in trade, service and government. An additional 14 percent of the employment was in agriculture, forestry, fishing and mining. In the West Division trade, service and government constituted 62 percent of total of 43,200 employed. Table 1-17 shows the employment in the Puget Sound Economic Area for 1960, 1963 and 1966 in fourteen industrial sectors and by division.

TABLE 1-17. Employment by major industrial sectors, Puget Sound Economic Area and Divisions, 1960-1963-1966 (thousands)

	1960				1963				1966				Average Annual Increase (Percent)	Central Division Percent of Total
	North	Central	West	Total	North	Central	West	Total	North	Central	West	Total		
Ag., For., Fish., & Mining	7.3	15.3	2.4	25.0	7.1	14.0	2.6	23.7	7.0	12.3	2.7	22.0	-2.1	56
Construction	4.0	32.2	1.6	37.8	2.8	36.3	2.1	41.2	4.3	43.7	2.0	50.0	4.8	87
Food & Kindred	2.2	13.3	0.9	16.5	2.4	12.6	0.9	15.9	2.1	13.1	0.9	16.1	-0.4	81
Forest Products Ind.	3.3	20.3	7.3	30.9	3.2	19.9	5.9	29.0	3.4	21.1	7.6	32.2	0.7	66
Chemicals	0.0	2.2	0.1	2.3	0.0	22.2	0.1	2.3	0.2	2.2	0.1	2.4	0.7	92
Petroleum	1.2	0.2	0.0	1.4	1.0	0.2	0.0	1.2	0.9	0.2	0.0	1.2	-2.5	17
Stone, Clay & Glass	0.4	2.9	0.1	3.4	0.4	3.3	0.1	3.8	0.4	3.4	0.1	3.9	2.3	87
Primary Metals	0.0	3.8	0.0	3.8	0.0	4.1	0.0	4.1	0.4	4.8	0.0	5.2	5.4	92
Other Non-Durable	0.7	13.5	0.5	14.7	0.7	13.8	0.5	15.0	0.7	16.0	0.6	17.3	2.8	93
Other Durable	0.7	77.7	0.3	78.7	0.8	85.2	0.2	86.2	1.2	116.0	0.3	117.5	6.9	99
Trans. Comm. & Pub. Ut.	2.1	36.3	1.4	39.8	2.1	36.7	1.5	40.3	2.3	41.5	1.7	45.5	2.3	91
Trade	8.3	119.3	5.9	133.5	8.3	125.3	6.3	140.0	9.6	142.9	7.8	160.3	3.1	89
Service	8.6	115.9	6.1	130.6	8.4	128.3	7.3	144.0	9.3	149.9	8.0	167.2	4.2	90
Government	7.5	88.5	9.7	105.8	8.3	97.2	10.2	115.8	9.1	113.1	11.2	133.3	4.0	85
Total	46.5	541.0	36.3	623.9	45.6	578.5	38.8	663.1	51.1	680.3	43.2	774.5	3.7	88

Underscored industries indicate heavy water consumers.
Source: *U.S. Department of Labor Washington State Department of Employment Security*

Since January 1966 the Anacortes area of the Skagit County in the North Division has been classified as an area of persistent substantial unemployment and is designated under Title IV of the Public Works and Economic Development Act of 1965 (Public Law 89-136) as a redevelopment area and qualified for public works grants and other economic assistance. The annual average unemployment rate in 1966 was 6.3 percent and 7.2 percent in 1967. This compares with a national average unemployment rate of 3.8 percent for both years. Employment in the Anacortes area is highly dependent upon logging operations, agriculture, food processing and sales and services to a summer tourist trade. These seasonal activities result in abnormally high rates of unemployment.

Federal and State Indian reservations which manifest a very high degree of economic distress and are recommended by the Bureau of Indian Affairs or an appropriate State agency, also qualify for Title IV assistance. Two Indian reservations in the Economic Study Area continue to qualify for this assistance as of January 1969, the Lummi Indian Reservation in Whatcom County (North Division), and the Makah Indian Reservation in Clallam County (West Division).[1]

[1] Economic Development Administration, U.S. Department of Commerce, Maximum Grant Rates for Public Works Grants in Qualified Areas under the Public Works and Economic Development Act of 1965, Public Law 89-136, January 31, 1969.

PERSONAL INCOME

Economic development is dependent on the level, of composition and trends of economic activity. Economic activity can be measured in terms of employment—employment characteristics and change—or in terms of the accomplishments of the employed. Accomplishments, in turn, can be measured by output of goods and services or by income paid to contributors of this output. Since there are regional and industrial differences in the "economic contribution" of each participant, income is regarded as a better measure of economic activity than employment. Personal income is probably the most comprehensive measure for regional analysis, because it is a gauge of both economic activity and purchasing power. Differences in per capita income result from differences in industrial composition, relative efficiencies of production within a given industry, non-income incentives, labor-force participation rates, and monetary price of goods.

PHOTO 7. A major industry in the Puget Sound Area is the manufacture and repair of heavy transportation equipment. In the period 1960-66, the average annual growth rate in manufacturing employment was 4.4 percent as compared with only 2.1 percent for the United States. As of 1966, the central division, which includes the Seattle-Everett-Tacoma metropolitan area, accounted for 88 percent of all employment in the Area. The urban character of the central division is reflected in the predominance of employment in manufacturing, wholesale and retail trade, services, and government. Seattle Times Photo.

National Trends

Trends in total personal income reflect changes in the number of people, amount of goods and services produced, and value of the monetary unit. Between 1940 and 1964, a period of no major depression, total personal income of the nation increased at an average annual rate of 4.4 percent, adjusted for a dollar of constant value. At this rate, total real income doubles every 16 years. During the same period, per capita personal income of the nation increased from \$1,316 to \$2,568, in terms of a constant value dollar. At this rate, real per capita income doubles every 25 years. The following Table 1-18 shows the national trends in personal income and per capita income for the period 1940-1964.

TABLE 1-18. Trends in personal income, United States 1940-1964

	Total Personal Income				Per Capita Personal Income	
	Current Dollars (Billions $)	Annual Average Increase (Percent)	1964 Dollars[1] (Billions $)	Annual Average Increase (Percent)	1964 Dollars[1]	Annual Average Increase (Percent)
1940	$ 78.7	11.2	$174.3	5.3	$1,316	3.8
1950	$228.5	6.0	292.5	3.7	1,926	2.0
1960	401.3	5.2	420.8	4.0	2,338	2.3
1964	491.4		491.4		2,568	
1940-1964		7.9		4.4		2.8

[1] Deflator: Consumer Price Index

Source: Council of Economic Advisors, Economic Report of the President, 1965, P. 205 & 244.

Regional Trends

Increases in personal income have progressed unevenly among geographical areas of the nation. During the 1940's and 1950's, the most rapidly expanding area increased at nearly twice the rate of the slowest-growing area. Between 1960 and 1964, this disparity decreased somewhat. For each of the areas there was close correlation between population rates of growth and personal income between 1950 and 1964. The correlation was weaker during the 1940-1950 decade. The following Table 1-19 ranks the percent change of personal income in various geographical areas of the United States for periods between 1940 and 1964.

From 1940 to 1950, total personal income in the Pacific Northwest increased by 245 percent, the second-highest rate in the nation. In recent years, its growth rate dropped to among the lowest, as the result of lower-than-average growth in employment and a relative decline in per capita income. In 1950, per capita income in the Pacific Northwest was 7.5 percent more than the national average, but in 1960 and 1964 it was nearly one percent less.

Per capita income among geographical areas is also markedly unequal, but the disparity is lessening. Between the two extreme divisions the ratio was 3:1 in 1930 and in 1940; to 2:1 by 1950, and became even less between 1960 and 1964. The tendency for

TABLE 1-19. Comparative trends in total personal income, United States geographical area 1940-1960 (based on current dollars)

1940-1950		1950-1960		1960-1964	
Area Division	Percent Increase	Area Division	Percent Increase	Area Division	Percent Increase
W. S. Central	247	California	120	California	30.0
Pac. Northwest	245	Mountain	110	So. Atlantic	29.5
California	236	So. Atlantic	87	Mountain	26.5
Mountain	235	United States	76	E. So. Central	26.4
E. So. Central	226	W. So. Central	75	W. So. Central	23.4
So. Atlantic	211	New England	71	United States	23.0
W. No. Central	205	E. No. Central	70	New England	22.5
United States	187	E. So. Central	69	Mid Atlantic	20.3
E. No. Central	185	Mid Atlantic	66	Pac. Northwest	20.1
Mid Atlantic	147	Pacific Northwest	62	E. No. Central	19.0
New England	137	W. No. Central	62	W. No. Central	17.8

Source: Economic Base, Willamette Basin Comprehensive Study, Willamette Basin Task Fore, Pacific Northwest River Basins Commission, 1969.

per capita income to shift toward the national norm was less pronounced in some regions from 1950 to 1964. In 1964, the extremes in per capita income were $1,745 in the East–South–Central states and $3,103 in California, while the national average was $2,568. The following Figure 1-6 demonstrates graphically the tendency of the differences in per capita personal income to move toward a narrow range for the divergent geographical areas of the United States.[1]

[1] Economic Base, Willamette Basin Comprehensive Study, Willamette Basin Task Force. Pacific Northwest River Basin Commission. 1969.

Puget Sound Economic Area

Trends in personal income in the Economic Study Area can be compared to the Pacific Northwest and the nation for the period 1950-1961. Total personal income in the Study Area increased 74 percent as compared to 57 percent for the Pacific Northwest and 70 percent for the Nation. The increases in each of the three divisions in this period were: North Division 57 percent, Central Division 78 percent and West Division 47 percent. Only the Central Division exceeded the national growth rate. Segregated by divisions within the Study Area, the following Table 1-20 shows the total personal income and per capita income for two years averages in 1950-1951 and 1960-1961.

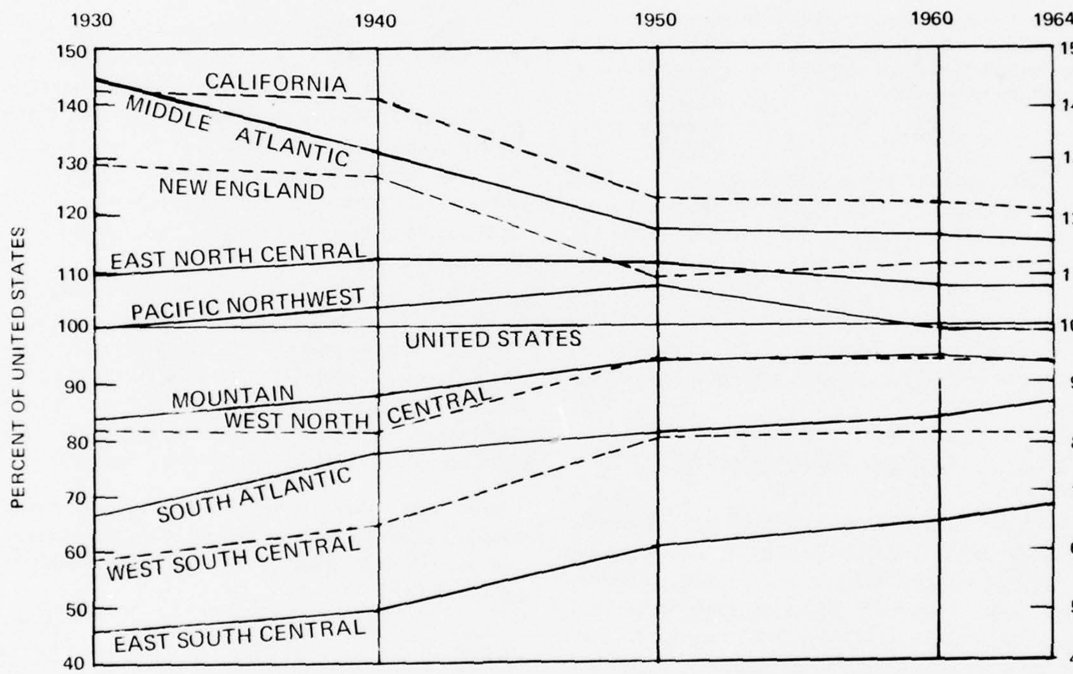


FIGURE 1-6. Relative differences in per capita personal income, United States Geographical Areas 1930-1964.

TABLE 1-20. Total personal and per capita income. Puget Sound Economic Area, 1950-51 and 1960-61[1]

Division	Total Personal Income (Millions of Current Dollars) 1950-51	1960-61	Per Capita Income 1950-51	1960-61
North	$ 178.6	$ 279.9	$1,537	$1,941
Central	2,233.5	3,967.6	1,867	2,622
West	147.7	217.7	1,508	1,962
Total	$2,559.8	$4,465.2	$1,805	$2,562
Pacific Northwest			$1,667	$2,227
United States			$1,569	$2,249

[1] A two-year average was taken from terminal periods in order to reduce the influence of marked fluctuations in income components associated with small areas.

Source: Personal Income, Volume II, Part 4 Pacific Northwest Economic Base Study for Power Markets—U.S. Dept. of Interior Bonneville Power Administration and U.S. Census of Population 1950 & 1960.

Per capita income in the Puget Sound Economic Area was greater than the Pacific Northwest and the Nation in both the 1950-51 and 1960-61 periods. The Central Division held the lead over the Study Area, the Pacific Northwest, and the Nation in both the time periods. However, the North Division and the West Division had less per capita income when compared with the same major areas in the same time periods.

VALUE ADDED BY MANUFACTURE

Value added by manufacture is an economic indicator which is developed by a special census (Census of Manufactures) conducted on an establishment basis. A company operating establishments at more than one location is required to submit a report for each location. Companies engaged in distinctly different lines of activity at one location are required to submit separate reports. The 1958 and 1963 Census of Manufactures covers all establishments primarily engaged in manufacturing in the 1957 edition of the Standard Industrial Classification Manual. The SIC Manual defines manufacturing as the "mechanical or chemical transformation of inorganic or organic substances into new products." The assembly of component parts of products is also considered to be manufacturing if the resulting product is neither a structure nor other fixed improvement. These activities are usually carried on in plants, factories, or mills which characteristically use powerdriven machines and materials-handling equipment.

Value added by manufacture is derived by subtracting the total cost of materials (including raw materials, supplies, fuel, electric energy, goods purchased for resale, and miscellaneous receipts) from the value of shipments and adjusting the resulting amount by the set change in finished products and work-in-process inventories between the beginning and end of the year. This derivation differs from that used in Exhibit D as prepared by the Consulting Services Corporation and used in the input-output analysis. In addition to the cost of raw materials the CSC study also subtracts purchases of services from sales.

The Puget Sound Economic Area, between 1958 and 1963, had an increase of about 47 percent in terms of value added by manufacturing which was greater than both the State of Washington and the United States. As shown in Table 1-21, two-thirds of the value added by manufacturing in Washington State is attributable to the Puget Sound Economic Area and 90 percent of the Area total is produced in the Area's Central Division.

In the period between 1958 and 1963 the Central Division experienced a 49 percent increase in value added by manufacturing. This was greater than the Economic Study Area, the State of Washington and the United States. The North Division showed a tremendous 73 percent increase, due to the relatively small base in 1958 that almost doubled by 1963.

TABLE 1-21. Value added by manufacture, Puget Sound Economic Area compared with Washington and the United States 1958 and 1963 (Millions current dollars)

Division	1958	1963	Percent Increase
North	$ 96	$ 167	73
Central	1,225	1,829	49
West	90	113	25
Total	$ 1,411	$ 2,109	49
State of Washington	$ 2,167	$ 3,029	40
United States	$141,532	$192,330	36

Source: U.S. Department of Commerce, Bureau of the Census County and City Data Book, 1967, a statistical abstract supplement.

PHOTO 8. The volume of retail sales is a direct result of personal income. As of 1960-61 the per capita income of the Puget Sound economic area was $2,526 as compared with the United States per capita income of $2,249. The central division had a per capita income of $2,622. Seattle Times Photo.

TRENDS AND PROJECTIONS BY INDUSTRY

GENERAL

The economic expansion of the Puget Sound Economic Area is the result of inter-action of many forces such as production, distribution, demand for goods and services and use of wealth. These forces can not be separated and accurately defined as some of these effects are internal within the economy and others are external. The sequence of economic development follows no set pattern or fits any formula because of the many events taking place without regard to time or place. The problem, therefore, is to make a projection which takes into account changes in technology, expected local production of goods now imported into the area, productivity increases, labor force participation rates; the changing pattern of consumer behavior as per capita incomes increase and the emergence of new industries. These projections, however, have been carefully constructed so as not to project economic output at a greater level than available supply conditions warrant.

The major element in selecting an approach to solve this problem was the availability of an input-output study developed by the University of Washington for the Washington State Department of Commerce and Economic Development. This analysis developed a model for the State of Washington as of 1963 by 56 industry categories. A summary of the findings for 27 industrial groups was published in the

University of Washington Business Review in February 1966 and are portrayed in Exhibit D of this appendix.

The input-output method presents the interrelation of industries in terms of sales and purchases. These procedures in current use were presented by Professor Wassily Leontief of Harvard more than 20 years ago. Survey of Current Business, November 1964, published by the U.S. Department of Commerce presented the industry relations of the United States for the year 1958, using the input-output method of analysis. The methodology used to develop trends and projections for this appendix followed these specific steps:

a. The major natural resource oriented industries of the Area were accorded detailed studies. Exhibits A through C contain the results of these investigations. The resources covered by these exhibits are agriculture, forests, and minerals.

b. Consulting Services Corporation of Seattle was employed to make the projections utilizing the inputs from the resource studies, the data available from the Washington State Input-Output Analysis and from supplementary studies. CSC adapted the model from the State of Washington as of 1963 to the Puget Sound Economic Area and used this model as a base for projecting a similar model for the year 1980. Projections were then made for the years 2000 and 2020. For some industries, particularly those in agriculture and forest products independent projections were made. For other industries the 17-year trend rates from 1963-1980 were extended to 2000 and 2020. Allowances were made for technological changes and productivity increases. Projections developed the future industrial output which in turn determined employment opportunities from which population estimates were derived.

Assumptions regarding the probable direction and level of national economic growth were adopted. These assumed trends and conditions specifically identify the constraints under which the projections were made. National assumptions for this study were those adopted by the Bonneville Power Administration and their economic study of the Pacific Northwest. All Government agencies and private consultants and universities which contributed to that study used these assumptions. These explicit assumptions were:

a. Sufficient quantities of water of acceptable quality will be available through timely development to avoid being a constraint to economic growth.

b. The Federal Government, as a matter of national policy, will actively support programs designed to stimulate economic growth.

c. There will be no general war nor any appreciable cessation of the cold war throughout the period to 1980. Expenditures on national security will continue to account for approximately 10 percent of the gross national product. After 1980, gradual disarmament will decrease the relative cost of military expenditures.

d. There will be a continued relaxation of trade tariffs and quotas and an accompanying expansion in international commerce.

e. United States population will expand to:

1980	259,584,000
2000	338,219,000
2020	469,126,000

f. The Federal Government will use its resources energetically to promote maximum employment, production and purchasing power. Accordingly, employment will prevail at approximately 96 percent of total civilian labor force throughout the forecast period.

g. United States Gross National Product will increase in billions of 1960 dollars to:

1980	$1,130
2000	$2,472
2020	$5,402

h. Development of technological process, together with expansion of worker's skills and capital formation, will increase productivity per manhour approximately 2.9 percent per year.

The findings of this study are briefly summarized in Table 1-22. By 1980, population is projected to expand over the 1963 figure by about 1 million, to 2.7 million persons. Gross regional production is expected to almost double to $11.4 billion in 1963 dollars. Employment is forecasted to rise approximately 1 million people. By-passing the year 2000 and observing the year 2020, the population is estimated to be 6.8 million with area employment projected at 2.4 million and a gross regional product of $68 billion.

As these results were consistent with past experience, the Puget Sound Task Force has accepted them as a basis for all of the technical studies and planning in the Puget Sound Area. The remainder of

TABLE 1-22. Puget Sound Economic Area—1963 and projected employment by major industry, population and gross regional product (population and employment in 000's)

No.	Employment by Industry	North Division 1963	North Division 1980	North Division 2000	North Division 2020	Central Division 1963	Central Division 1980	Central Division 2000	Central Division 2020	West Division 1963	West Division 1980	West Division 2000	West Division 2020	Puget Sound Economic Area 1963	Puget Sound Economic Area 1980	Puget Sound Economic Area 2000	Puget Sound Economic Area 2020
1	Agri., For., Fish., & Mining[1]	7.1	6.0	5.3	4.7	14.0	9.9	6.6	4.8	2.6	2.3	1.6	1.5	23.7	18.2	13.5	11.0
2	Food & Kindred Products	2.4	2.2	2.5	2.8	12.6	15.9	18.7	21.0	.9	1.4	1.6	1.8	15.9	19.5	22.9	25.6
3	Lumber & Wood Products[2]	2.1	1.5	.4	.1	13.1	5.2	1.8	.6	4.4	1.7	.6	.2	19.7	8.3	2.8	.9
			(2.7)	(2.3)	(1.9)		(10.7)	(9.3)	(8.2)		(3.6)	(3.1)	(2.8)		(17.0)	(14.7)	(12.6)
4	Paper & Allied Products[2]	1.1	2.3	2.5	2.0	6.8	8.5	9.3	7.2	1.5	3.8	4.1	3.2	9.4	14.7	15.9	12.4
			(1.2)	(1.3)	(1.1)		(10.7)	(6.0)	(5.1)		(3.4)	(3.6)	(3.1)		(10.3)	(10.9)	(9.3)
5	Chemicals	•	•	•	•	2.2	1.8	1.3	.9	.1	•	•	•	2.3	1.9	1.4	1.0
6	Petroleum Refining	1.0	1.2	1.2	1.2	.2	.2	.2	.2	•	•	•	•	1.2	1.3	1.4	1.3
7	Stone, Clay & Glass	.4	.5	.7	.8	3.3	4.5	5.8	7.1	.1	.1	.1	.1	3.8	5.0	6.5	8.0
8	Primary Metals	•	3.5	4.2	4.8	4.1	3.8	4.5	5.1	•	•	•	•	4.1	7.3	8.7	9.9
9	Other Non-Durable Mfg.	.7	.5	.7	.8	13.8	19.0	24.3	29.8	.5	.2	.3	.3	15.1	19.7	25.2	30.9
10	Other Durable Mfgrs.	.8	1.3	2.8	5.9	85.2	174.0	377.1	780.1	.2	.3	.7	1.5	86.2	175.7	380.7	787.4
11	Trans., Com., & P.U.	2.1	2.7	2.3	1.8	36.7	32.1	26.3	20.6	1.5	1.4	1.2	.9	40.2	36.2	29.7	23.3
12	Whsle. & Retail Trade	8.3	11.1	16.0	22.0	125.3	187.0	269.8	371.5	6.3	4.5	6.5	9.0	140.0	202.6	292.3	402.4
13	Services	8.4	10.0	16.9	27.3	128.3	214.2	362.0	584.0	7.3	5.9	9.9	16.0	144.0	230.1	388.8	627.3
14	Construction	2.8	2.8	3.7	4.5	36.3	49.6	64.2	79.4	2.1	2.0	2.7	3.3	41.2	54.5	70.5	87.2
15	Government	8.3	12.3	19.0	28.0	97.2	147.5	227.9	336.1	10.2	18.3	28.3	41.7	115.8	178.1	275.1	405.8
	Total Employment[4]	45.5	57.9	78.2	106.7	579.1	873.2	1399.8	2248.4	37.7	41.9	57.6	79.5	662.6	973.1	1535.4	2434.4
	Total Population	151.0	185.5	249.9	341.5	1603.0	2418.9	3882.1	6235.5	116.0	122.5	169.5	232.4	1870.0	2726.9	4300.5	6809.4
	Gross Regional Product (millions 1963 $'s)	$369	848	1,800	3,977	5,172	10,022	24,569	62,061	290	498	1,066	1,329	5,830	11,358	27,436	68,248

1 Underlined industries are large users of water.

2 Employment in ( ) represents projections made by Forest Service, U.S. Department of Agriculture which were made available after completion of the input-output study as found in Exhibit D. The Forest Service projections will be utilized for planning purposes.

3 • Less than 50 employees.

4 Figures may not add to totals due to rounding.

this appendix summarizes the results of each of the independent natural resource studies, the work of the Consultant, evaluates the implications of the findings and compares them with other projections made by the Office of Business Economics Research, Department of Interior.

AGRICULTURE

General

The study of the Agricultural Resource, Exhibit A, projected future activity in terms of quantity and value of agricultural production, crop acreage, land use, number of farms, rural farm population and employment. In addition, the study provided projections of input-output relationships in agriculture.

The starting point was past behavior in the production of major agricultural commodites. The following six commodities were identified as dominating the total output mix—vegetables, berries, hay, milk, eggs, and broilers. Moreover, the Puget Sound Area was found to be a relatively important contributor to total State output of these commodities. The 1963 area's share of Washington production were estimated to be as follows: 38 percent of vegetables, 68 percent of berries, 15 percent of hay, 68 percent of broilers, 64 percent of milk and 62 percent of eggs.[1]

Changes in output of all commodities, using Census of Agriculture data for 1954, 1959 and 1964 were examined. Past trends in quantity of output and value of sales were extrapolated to 1980. As a test for consistency, the projected changes were compared with those derived from the regression equations generated from Statistical Reporting Service data and were found to be generally of the same order. Subsequent steps in the analysis of the agricultural economy involved analyses to relate present and future development to exogenous factors which should be expected to influence growth.

The net ability of local producers to compete with suppliers from outside the region was evaluated by means of location quotients, as explained in Exhibit A. Final projections of products were finally generated utilizing the framework of analysis as developed. First, vegetable and berry outputs were projected on the basis of projected increases in national consumption, derived from assumed changes in population and per capita consumption. The procedure for generating projections to the periods 2000 and 2020 were, of necessity, less rigorous. Essentially, they were developed by extending the 1963-1980 trends, with the constraint upon total land available providing a dampening effect to expansion. Projections for the Puget Sound Area were highly dependent upon the interindustry study of the State of Washington as described in Exhibits A and D.

1 Estimates derived from data provided by Statistical Reporting Service and Census of Agriculture, U.S. Department of Agriculture.

Land Use—Number and Size of Farms

In the Puget Sound Economic Area, about 1 million acres, or approximately 10 percent of the total land area, is land in farms. In contrast, 45 percent of the total land area in the State is classed as land in farms. This relatively low concentration of agricultural land in the area is to be expected as the Puget Sound Area contains the largest single urban-industrial complex in the Pacific Northwest. Recent declines in the amount of farmland in the area have been associated with urban population growth and industrial expansion.

In 1963, the allocations of land in farms to major uses were as follows: (1) cropland—486,000 acres, (2) pastureland—289,000 acres, (3) woodland—221,000 acres, and (4) other land—57,000 acres, (Table 1-23).

TABLE 1-23. Land in farms, Puget Sound Economic Area, 1963, 1980, 2000, 2020 (acres)

Land Use	Current Acreage 1963[1]	Projected Acreage 1980	2000	2020
Cropland	486,000	367,000	299,000	225,000
Pastureland	289,000	220,000	191,000	176,000
Woodland	221,500	200,000	96,000	46,000
Other Land	57,000	36,000	22,000	13,000
Land in Farms	1,053,500	823,000	608,000	460,000

1 Estimated from Census of Agriculture.

Source: Exhibit A, Table 5.

In that year the Central Division contained 402,750 acres; North Division had 393,750 acres, and the West Division contained 257,000 acres of land in farms. Between 1950 and 1963 the total land in farms for the area declined 23 percent; cropland declined 17 percent; pastureland declined 20 percent; wood-

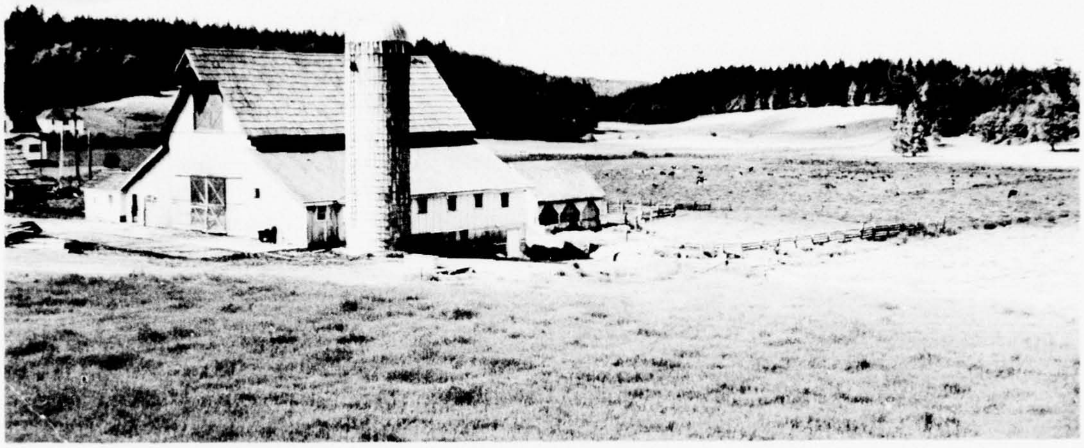


PHOTO 9. As of 1963 the Puget Sound economic area contained about 1 million acres of land in farms on 10 percent of the total land area. In comparison, about 45 percent of the total land area in the State of Washington is classed as land in farms. Over the study period 1963-2020, farm land use is expected to decline due mainly to the expansion of the urban-industrial complex of Seattle-Everett-Tacoma. Seattle Times Photo.

land declined 33 percent; and other land declined 41 percent. During the same period, the net shifts of land out of agricultural use represented 18 percent of the farmland in the North Division and 26 percent of the farmland in the Central and West Divisions.

Two characteristics seem to dominate the change in land in farms—first, the stability of the rate of decline in all farmland, and second, the steady increase in the proportion of farm land used for crops and/or pasture. On the strength of expectations for overall changes in regional land use, an assumption was made that these trends will continue except for some of the agricultural lands which can be preserved through proper land use regulations. On this basis, the quantity of land in farms has been projected to decline. Of particular importance are the following compositional changes: (1) the greatest absolute and relative shift in land use will occur in the Central Division; (2) the proportion of farmland used either for crops or for pasture will increase substantially; and (3) the North Division will contain the major share of land in farms. On the basis of past experience, land use shifts have been predominent on the periphery of the Seattle-Tacoma-Everett metropolitan complexes in the Central Division.

The number of farms in the Puget Sound Economic Area has declined at an approximate rate of 4 percent per year since 1954.[1] This stands out, as it is a rate of decline nearly double that of the entire Pacific Northwest. The difference is largely due to losses of farmland in the Puget Sound Area since the Pacific Northwest has experienced slight increases in land in farms over a comparable time period.

While declines have occurred in the number of farms in all sizes, nearly 90 percent of the reduction can be found in units of less than 50 acres. Since 1954 the annual rates of decline range from 13.7 percent for farms of less than 10 acres to just 0.5 percent for farms greater than 260 acres in size. The result has been to increase the size of the average unit from 49 acres to 64 acres, an increase of 31 percent.

The projections of number of farms (shown in Table 1-24) indicate a continuing, but less rapid decline. As the change is farm size distribution

[1] Estimated from the Census of Agriculture.

continues, the large loss in farms of less than 50 acres will weigh less heavily. Moreover, the incentive for consolidation will probably be less influential as the average size of farms increase. Thus, the most important factor in determining changes in farm numbers will be changes in the amount of land in farms.

TABLE 1-24. Puget Sound Economic Area. Number of farms 1963, 1980, 2000 and 2020

	Number of Farms			
	1963[1]	1980	2000	2020
Division	Number	Number	Number	Number
North	5,050	3,380	2,800	2,350
Central	7,520	3,900	2,550	1,750
West	2,450	1,770	1,350	1,000
TOTAL	15,020	9,050	6,700	5,100

During the 10-year period from 1954 to 1964, the average value of land and buildings per farm increased by 158 percent. Some of the increase in value per farm unit may be attributed to the increase in physical size. However, a greater share is related to the increase in value per acre; i.e., the average value of land and buildings per acre increased 97 percent in the 10-year period.[1] This latter increase is associated with two separate factors: (1) land and other real assets have appreciated in value, and (2) capital investment has increased.

Farm Production

Significant changes have taken place in the quantity and composition of crop production. Between 1959 and 1964 the following changes occurred: (1) the production of hay declined 7 percent, (2) the production of small grains dropped 68 percent, (3) the production of vegetables increased 40 percent, (4) the production of berries increased 3 percent, and (5) the production of tree fruits and nuts dropped 60 percent.[1] The 1963 levels of crop production, with additional information on acreage, yield, and value are shown in Table 1-25.

1 Estimated from the Census of Agriculture.

Projections of farm crop production is given in Table 1-26. These projections utilized information gathered about land availability, crop yields and markets. Important factors in formulating these projections shown in Table 1-26 include the following: (1) the total amount of cropland acreage was projected for future time periods; (2) the production of vegetables and berries was projected to be consistent with the growth in market demand;[2,3] (3) the changes in yields for vegetables, berries, and other crops were projected to be consistent with work done by Poli[4] and others;[5] (4) the acreage of vegetables and berries was derived and the residual acreage in all other crops determined; (5) the acreage of residual cropland was allocated among other major crops according to recent trends; and (6) the production of the remaining major crops was derived from allocated acreages and yield projections.

2 U.S. Department of Agriculture, Economic Research Service, Agricultural Production and Food Processing in the Pacific Northwest, 1960-1985 Administrative report to BPA, Department of the Interior, Corvallis, Oregon, July 1964.

3 Preliminary unpublished projections have been developed by the U.S. Department of Commerce and Agriculture under the auspices of a program "Economic and Statistical Analysis and Projections for Comprehensive River Basin Planning" sponsored by the Water Resources Council.

4 Poli, Adon, "Long-term Production Prospects for Western Agriculture" U.S.D.A., Agricultural Economics Report No. 33, FPED-ERS, May 1963.

5 USDA, ERS, Agricultural Production and Food Processing in the Pacific Northwest, 1960-1985, op. cit.

TABLE 1-25. Puget Sound Economic Area. Production, acreage, yield and value of production of major crop group, 1963[1]

Crop Group	Production Tons	Acreage Acres	Yield Tons/acre	Value of Production $1,000
Small grains				
PS&AW	17,490	16,500	1.1	812
State	3,001,144	2,781,000	1.1	168,505
Percent	0.6	0.6		0.5
Field crops				
PS&AW	35,060	3,280	10.7	979
State	2,324,750	377,000	6.2	75,190
Percent	1.5	0.7		1.3
Hay				
PS&AW	301,000	145,000	2.1	6,499
State	1,976,000	854,000	2.3	45,855
Percent	15.0	17.0		14.2
Silage				
PS&AW	373,000	42,000	8.9	2,706
State	1,065,700	93,400	11.4	8,090
Percent	35.0	45.0		33.4
Vegetables				
PS&AW	170,500	45,635	3.7	10,699
State	486,600	137,640	3.5	30,559
Percent	38.0	33.2		35.0
Fruits and Nuts				
PS&AW	2,000	2,000	1.0	234
State	1,058,800	132,350	8.0	89,332
Percent	0.2	1.5		0.3
Berries				
PS&AW	29,734	8,760	3.4	8,399
State	43,734	13,840	3.2	11,309
Percent	68.0	63.3		74.3

[1] Estimated from Statistical Reporting Service and Census Agriculture.

TABLE 1-26. Puget Sound Economic Area. Production by major crop groups—1963, 1980, 2000 and 2020 (Tons)

Crop Group	Production			
	1963[1]	1980	2000	2020
Small grains	17,490	1,490	900	
Field crops	35,060	30,000	26,000	26,000
Hay	301,000	255,600	158,000	55,000
Silage	373,000	238,000	145,000	64,000
Vegetables	170,500	307,300	440,000	603,000
Fruits and nuts	2,000	650		
Berries	29,735	45,100	61,000	77,000

[1] Estimated from Census of Agriculture and Statistical Reporting Service, U.S.D.A.

PHOTO 10. Field-corn harvest. Substantial changes in crop production are projected for the Puget Sound Area. Production of vegetables is predicted to increase by about 250 percent, and berries by 160 percent in the period 1963-2020. The production of hay and silage is expected to decline by an estimated 80 percent, and the production of field crops is *expected to decrease* by an estimated 25 percent over the same time period. Seattle Times Photo.

Substantial changes in crop production are projected for the region. Production of vegetables and berries is expected to increase by an estimated 250 percent and 160 percent, respectively, by 2020. The production of hay and silage is expected to decline by an estimated 80 percent and the production of field crops is expected to decrease by an estimated 25 percent over the same time period. The production of all other crops will become an insignificant factor in the regional economy.

The projections of crop production are converted to value of output projections (Table 1-27) based upon a set of current normalized prices for agricultural products.[1]

[1] From unpublished data prepared by Economic Research Service, U.S. Department of Agriculture.

TABLE 1-27. Puget Sound Economic Area. Value of production by major crops groups—1963, 1980, 2000 and 2020

	Value of Production			
Crop Group	1963[1] $1,000	1980 $1,000	2000 $1,000	2020 $1,000
Small grains	812	69	42	--
Field crops	979	838	726	726
Hay	6,498	5,518	3,411	1,188
Silage	2,706	1,726	1,051	464
Vegetables	10,699	19,283	27,610	37,838
Fruits and nuts	234	76	--	--
Berries	8,400	12,740	17,231	21,751
ALL CROPS	30,328	40,250	50,071	61,967

[1] Estimated from Census of Agriculture and Statistical Reporting Service, U.S.D.A.

Three major products dominate and sustain the livestock sector of the Puget Sound Economic Area: milk, eggs, and broilers. All other livestock products have declined in importance over 1953-63 period. Analysis using "concentration coefficients" has indicated that the output of the three major livestock products shown in Table 1-28 has been geared to the needs of the local market; exports have not been a factor of great importance.

The one potential restriction on the supply of the major dairy poultry products is the inability of the Area to provide the feed and forage required for production. However, most of the feed grains and an increasing share of forage are being profitably imported into the Area.

The value of output of livestock and livestock products is projected as shown in Table 1-29. The prices used represent current normalized prices, assumed to remain relatively stable over the projection period.

TABLE 1-28. Puget Sound Economic Area. Production and value of production by livestock and livestock product group, 1963[1]

Major Commodity	Number	Unit of Measurement	Quantity Produced	Value of Production
	Thousands	*Million*	Millions	Thousand Dollars
Cattle and Calves				
PS&AW	320	lbs. lv. wt.	82	16,266
State	1,360	lbs. lv. wt.	394	77,776
Percent	24		21	21
Hogs and Pigs				
PS&AW	16	lbs. lv. wt.	5	846
State	120	lbs. lv. wt.	39	6,506
Percent	13		13	13
Sheep and Lambs				
PS&AW	15	lbs. lv. wt.	1	171
State	230	lbs. lv. wt.	16	2,630
Percent	6		6	6
Chickens				
PS&AW	3,300	lbs. lv. wt.	8	598
State	5,300	lbs. lv. wt.	14	973
Percent	62		62	62
Turkeys				
PS&AW	107	lbs. lv. wt.	2	439
State	445	lbs. lv. wt.	9	1,825
Percent	24		24	24
Broilers				
PS&AW	11,965	lbs. lv. wt.	44	7,456
State	17,607	lbs. lv. wt.	64	10,972
Percent	68		68	68
Milk				
PS&AW		lbs.	1,228	53,084
State		lbs.	1,920	82,944
Percent			64	64
Eggs				
PS&AW		Number	650	18,406
State		Number	1,049	29,687
Percent			62	62
Wool				
PS&AW		lbs.	1	44
State		lbs.	2	810
Percent			5	5

Source: Statistical Reporting Service and Census of Agriculture.

PHOTO 11. An idyllic pastural scene is provided by a barn built in 1915 in the Snohomish River Basin. The major livestock products of the Puget Sound economic area are milk, eggs, and broilers. The value of production of livestock and livestock products is expected to increase from $97 million in 1963 to approximately $211 million by 2020. Seattle Times Photo.

TABLE 1-29. Puget Sound Economic Area. Value of production of livestock and livestock products, 1963, 1980, 2000 and 2020

	Value of Production (in $1000)			
Major Commodity	1963[1]	1980	2000	2020
Cattle & calves	16,266	19,254	23,488	28,673
Hogs & pi	846	412	412	412
Sheep & lambs	171	72	72	72
Chickens	598	699	853	1,049
Turkeys	439	189	189	189
Broilers	7,456	10,982	14,807	18,020
Milk	53,084	67,223	88,794	116,721
Eggs	18,406	25,767	34,707	46,695
Wool	44	31	31	31
All livestock & livestock prod.	97,310	124,629	163,353	211,862

[1] Estimated from Census of Agriculture and Statistical Reporting Service

With utilization of the input-output methodology the four agricultural sectors (field crops, vegetables, livestock and products, and other agricultural products) produced a gross output of nearly $136 million in 1963. Of this amount, 40 percent, or $54 million represents the value added by employing the human, natural and capital resources of the area in agricultural activities. In addition, $65 million of the gross agricultural output represents purchases from other industries within the Puget Sound Economic Area, $16 million represents the imports needed for production by regional agriculture. Over $100 million, or nearly 74 percent, of the agricultural output was purchased by other industries within the area for additional processing. Most of the remaining production, $32 million, or 24 percent, was purchased by consumers within the area. About 2

percent of area farm output was exported by the agricultural sectors.[1]

The projection of total 1980 flows in agriculture was derived from the projections of production, described above. Future levels of factor productivity are related to changes in crop yields, feed efficiencies, size of operating units, and labor productivity. An indication of the change in factor productivity is that purchases from other industries in the Area are assumed to increase 21 percent, from $65.3 million to $79.1 million, while total output is assumed to increase 33 percent. Imports are assumed to increase approximately 32 percent over the same period. The relative increase in imports over Puget Sound Economic Area purchases can be attributed to increased imports of forage inputs by the livestock sector and does not represent widespread import substitution. Another measure of gains in productivity may be found in comparing the percentages of output attributed to value added for the two periods. In 1963, 40 percent of output was returned to capital, labor, and land. By comparison, value added is projected to reach 44 percent by 1980. The real significance is somewhat greater than this difference may indicate since physical inputs of both land and labor are projected to decline during the period.

Farm Population and Employment

Between 1950 and 1960, the rural farm population declined 56 percent. This change is related to the reduction in number of farms, the one factor which has had the largest single influence on changes in rural farm population in the area. Other factors which affect the size of the rural farm population include: (1) the size of farm households (person per household), (2) the proportion of farms which serve as a place of residence, and (3) the proportion of farms which are located in areas classified as "rural" in the Census of Population.

The projections of rural farm population (Table 1-30) have given the greatest weight to changes in number of farms as determining future population levels; thus, population is projected to decline substantially. The potential for change in the size of farm households is assumed to be limited since the farm family is now, at 3.61 persons per household, nearly the same size as all other families and is not changing rapidly. The proportion of farms which serve as a place of residence, approximately 96 percent, is a factor which displays a high degree of stability. However, the final factor, whether or not the farm is determined to lie within a rural area, can be subject to substantial change. The projections of rural farm population for the area and for the three economic divisions (Table 1-30) are based upon the assumption that there will be little change in this factor. For the North and West Divisions, this assumption is quite a reasonable one, but it is possible that nearly all of the census divisions of the Central Division which contain farms will be classed as "urban" prior to 2020. Therefore, an alternative projection might be developed which would essentially eliminate most or all of the rural farm population from the Central Division.

TABLE 1-30. Puget Sound Economic Area. Rural farm population, 1963, 1980, 2000 and 2020.

	Rural Farm Population			
	1963[1]	1980	2000	2020
Division	Number	Number	Number	Number
North	16,150	10,050	8,325	6,980
Central	17,850	8,900	5,800	3,980
West	7,000	4,850	3,700	2,740
TOTAL	41,000	23,800	17,825	13,700

[1] Estimated from Census of Population, Bureau of the Census, U. S. Department of Commerce.

Between 1950 and 1960, the number of employees on farms in the Puget Sound Economic Area dropped nearly one-third.[2] Increased use of machinery and the adoption of large scales of operation have increased the average productivity of labor. Further, the increased use of other purchased factors, e.g., fertilizer and pesticides, has boosted the output per worker.

While farm employment has declined, the reduction has not matched the decline in the number of farms. The number of employees per farm enterprise increased somewhat over the last 10 years. Nevertheless, changes in total farm employment have been more closely related to the changes in farm numbers than any other single factor. At least three elements can be identified, however, which have some effect in changing the ratio of employees per farm; these are: (1) the scale of operation, measured as output per

[1] See Exhibit A for tables on interindustry purchases and sales for agriculture. Agricultural exports out of the Study Area include both processed and unprocessed farm production.

[2] Census of Population and Census of Agriculture.

farm, (2) labor productivity, and (3) the proportion of all farms which are commercial operations. While increasing labor productivity tends to decrease the ratio of employees per farm, the effects of increasing scale of operation and of increasing proportion of commercial farms have dominated in the recent past; thus, the ratio of employees per farm has risen slightly.

The projections of farm employment shown in Table 1-31 reflect an expected continuation of past trends with some modifications. The largest component of change in farm employment will continue to be the decline in number of farms. An additional factor leading to decreased farm employment will be the continued increase in labor productivity. Counter forces to a decline in employment will be provided by increased scale of farm operation and increased proportion of commercial farms, but the influence of the latter will substantially disappear before the end of the projection period. Thus, it is projected for 2000 and 2020 that the ratio of employees per farm will stabilize at around 1.55.

TABLE 1-31. Puget Sound Economic Area. Employment in Agriculture, 1963, 1980, 2000 and 2020

Division	1963[1]	1980	2000	2020
North				
Family	4,800	3,000	2,400	2,050
Hired	1,600	2,100	2,000	1,750
Total	6,400	5,100	4,400	3,800
Central				
Family	6,100	3,400	2,200	1,500
Hired	5,400	4,500	2,400	1,300
Total	11,500	7,900	4,600	2,800
West				
Family	2,000	1,440	1,100	850
Hired	300	560	400	350
Total	2,300	2,000	1,500	1,200
Puget Sound Economic Area				
Family	12,900	7,840	5,700	4,400
Hired	7,300	6,060	4,800	3,400
Total	20,200	13,900	10,500	7,800

[1] Estimated from Census of Population and Labor Force and Employment in Washington State.

Source: Exhibit A.

TIMBER RESOURCES AND FOREST INDUSTRIES

General

The purpose of Exhibit B, Prospective Timber Supplies and Forest Industrial Development, is to provide an analysis of present and projected timber resources and forest industries in the Puget Sound and Adjacent Waters Area. This synopsis of the forest resource Exhibit[1] presents trends and projections on the inventory of growing stock and sawtimber, i.e., production, output, consumption and employment. Principal markets for the timber products of the Puget Sound Area lie outside the State and are widely distributed over the nation. Therefore, the future forest industry of the Area will be strongly influenced by national demand.

National demand for wood products has been projected in the Forest Service report, "Timber Trends in the United States,"[2] and this projection was related to estimates of available timber supply in the report, "Prospective Economic Developments Based on the Timber Resources of the Pacific Northwest."[3] Since these two studies were completed, new economic information has been obtained concerning timber demand and supply. The estimates of available timber supply in western Washington have increased due to updating of inventory information and the decision of the State of Washington and the Bureau of Indian Affairs to increase allowable cut levels. The increasing world-wide demand for wood products, especially in the Pacific rim countries,

[1] Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound and Adjacent Waters Area, Pacific Northwest Forest and Range Experiment Station, U.S. Department of Agriculture, Exhibit B, December 1968.

[2] Forest Service, U.S. Department of Agriculture Timber Trends in the United States. Forest Resource Rep. No. 17, 1965.

[3] Gedney, Donald R., Newport, Carl A., and Hair, Dwight. Prospective economic developments based on the timber resources of the Pacific Northwest. (Specially prepared by the Pacific Northwest Forest & Range Exp. Sta. under cooperative agreement with the Bonneville Power Administration as a part of their "Pacific Northwest Economic Base Study for Power Markets," V. 2, part 6.) U.S. Dep. Interior, Portland, Oreg. 1966.

assures a continual high level of demand for wood from the Pacific Northwest.[1,2] This tends to support the concept that future production of forest products will be most limited by the economically available timber supply (Gedney, et al. 1966). Thus, it is assumed that the predicted higher levels of roundwood production will be marketed in the future. The future production of wood products in the Puget Sound Area was developed on the basis of these assumptions:

Population By 1985, population of the United States is expected to rise to about 260 million persons and to 325 million by the year 2000. The projection approximates the median of a series of projections published by the U.S. Bureau of the Census (1964) and is roughly 10 percent lower than that of the preceding series prepared in 1960 for the Senate Select Committee on Water Resources.[3]

Households Households in the United States have been projected to increased from 54.7 million in 1962 to 101 million in 2000. The number of persons per household is expected to continue to decline from 3.41 in 1962 to 3.22 in 2000.

Gross national product. Based on an increased population, recent trends in productivity and other factors, the gross national product is projected to increase 2.2 times, to $1,175 billion (1961 dollars) by 1985, and will continue to rise to $1,920 billion by the year 2000.[4]

Disposable personal income. Disposable personal income in 1962 was $379 billion (1961 dollars), is expected to rise to $960 billion in 1990, and to $1,340 billion in 2000. Disposable personal income per capita is expected to more than double between 1962 and the year 2000, rising from $2,030 to $4,120 (1961 dollars).

Construction activity. Past trends in use and statistical analysis of historical relationships indicate that the use of industrial raw materials will rise about 1.5 times by the year 1985. Four-fifths of the annual consumption of lumber and plywood production, nearly all of the pole and piling production, and substantial quantities of other industrial timber products are used for construction activity in the United States. Construction expenditures are expected to double by 1985, and the consumption of construction materials is expected to increase 55 percent during the same period. It was assumed that the relative price of timber products and competing materials would remain stable, and therefore industrial timber products would maintain their relative position in the mix of industrial materials about 22 percent.

Trends in forest management. It was assumed that the trend of an increasing level of forest management including protection, reforestation, utilization, and intermediate timber harvests would continue.

Allowable cuts from public lands. The estimates for future cuts from public lands National Forests, State, and Bureau of Land Management are planned levels of cut based on each agency's estimates of future conditions. They generally take into account expectations of an increased intensity of management on the lands under their control.

Prospective cut from private lands. This was estimated as the level of cut likely to occur under an extension of past levels of production into the future as modified by changes in the relationship between timber growth and inventory.

Land use. No substantial change in the amount of commercial forest land available for timber production was assumed except on private lands adjacent to Puget Sound.

[1] The FAO has prepared a report titled "Wood: World Trends and Prospects." This study shows that by 1975 the big net importers of wood will be northeastern Europe, Japan, and the United States. Canada, the USSR, and Scandinavia are expected to increase their export of pulp products and sawn softwoods (Unasylva Vol. 20 (1-2), numbers 80-81, 1966).

[2] Mr. A. D. Stevenson in an article titled "The Timber Importer" printed in *The Australian Timber Journal* (October 1965), stated that, "In 1964, we (Australia) imported 226 million super feet of softwoods from the West Coast of North America, principally Douglas-fir (Oregon), together with smaller quantites of Canada pine (hemlock and balsam), western red cedar and Californian redwood. However, the huge and ever-increasing American domestic market lies virtually astride our supply lines, and it is anyone's guess as to whether and for how long we can expect to be able to compete with it for a guaranteed supply of this valuable wood at present rates, let alone the increase which our own foresters tell use we are going to need from somewhere."

[3] Projections are lower than those assumed by Consulting Services Corp. in Exhibit D.

[4] Projections are lower than those assumed by Consulting Service Corp. in Exhibit D.

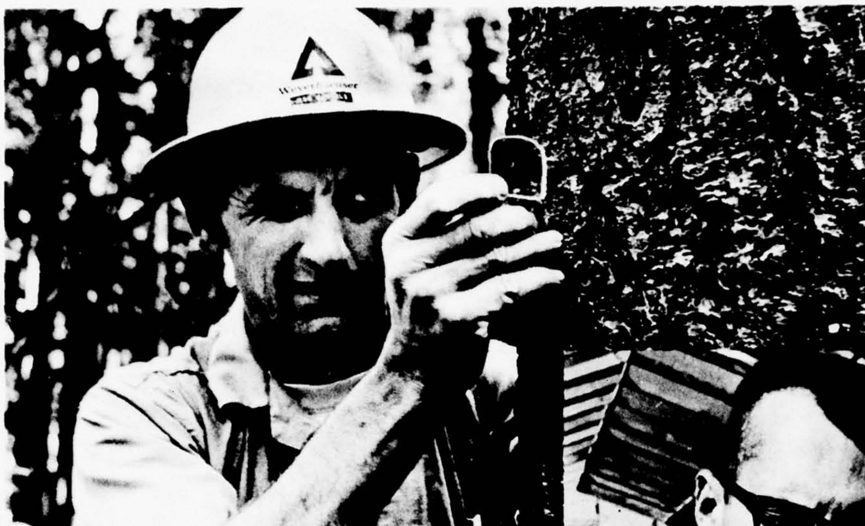


PHOTO 12. Forest management practices consider the growing of trees like any other agricultural crop that can be harvested periodically. To satisfy the increasing demand for lumber and paper products superior type trees are being developed. The per acre volume of timber production is expected to increase with the growing and harvesting of these superior type trees. Weyerhaeuser Co. Photo.

Raw material exports.—Continued supply from the Puget Sound Area of a substantial amount of wood in the form of logs to the Orient in the future was assumed. The Japanese economy is expected to import most of this roundwood. Present trends in log exports to Japan far exceed those forecast in either of the two recent Forest Service reports. The estimates used in the Puget Sound Study are based on the report prepared by G. S. Crawford, for the British Research Council, titled, "The Japanese Lumber Market" (1965). Although the Puget Sound Area's share of the total projected Japanese export market is expected to decreased in the late 1960's and early 1970's, the absolute volume of log exports is projected to increase above the 1963 levels to the year 1980 and then decline. This downward trend in the 1980's reflects both the anticipated decline in the Japanese export market and the increasing domestic demand for softwood in the United States.

Based on these assumptions, forest industry employment was projected for the period 1965-2020. Projections were made by the following major industry groups: logging, sawmills and planning mills, veneer and plywood plants, paper and allied products, and miscellaneous wood products. With the exception of employment in the export of logs, employment data are based on statistics which include only those workers directly employed by wood-using industries, as reported by the Employment Security Department as covered employment. No attempt was made to include other less direct employment, such as for servicing equipment used in wood products industries.

Productivity of workers in the forest industry has been increasing due to automation and mechanization. The result of this increase has been a reduced employment per unit of production. Productivity is expected to continue to increase in the future, although at a slower rate. Employment projections for the basin were made by applying productivity trends for specific industries to the estimates of their log consumption for the study period. The changes in forest product manufacturing brought about by changes in effective demand and raw material supply was also taken into consideration.

Growing Stock and Saw Timber

The timber resources of the Puget Sound Area have been used extensively for a long period of time. Because timber was easily accessible from the Sound, the forests were heavily cutover in areas nearest the shoreline in the first half of this century. These low elevation lands are now stocked with young-growth forests. At the higher elevations, especially in the Cascade Range and to some extent in the Olympic Range, forests consist mainly of old-growth timber. The complex of young- and old-growth forests is reflected in forest management practices in the Area. On public lands the rate of harvest of old growth timber is increasing; on private lands the annual timber harvest has been declining pending adjustment to a young-growth timber economy.

The Central Division contains 53 percent (2.6 million acres) of the commercial forest land in the Puget Sound Area. King, Pierce, and Snohomish Counties account for 88 percent of the commercial forest land in this division and 46 percent of the commercial forest land in the Puget Sound Area. These same three counties are experiencing the greatest growth in population in the Area, with consequent increasing pressure for land use other than timber production.

The North Division accounts for 19 percent (1.5 million acres) of the Area's commercial forest land. Skagit and Whatcom Counties, the two larger and more important forested counties in the division have 89 percent of the commercial forest area in the North Division. In 1968 the rugged and mountainous eastern portions of these two counties were converted to National Park and National Recreation Area Status under provisions of Public Law 90-544. This change is incorporated into this report.

Commercial forest land in the West Division represents 18 percent (913,000 acres) of the Puget Sound Area's total. A large amount of the commercial forest area consists of dry, relatively flat land along the shores of Puget Sound and Hood Canal. The remaining commercial forest area presents a more varied forest condition in terms of both topography and timber species; it extends from the shores of Hood Canal over the foothills of the Olympic Mountains to Olympic National Park. Old-growth timber stands and young-growth stands occur side by side on these hills with the older timber generally owned by public agencies.

Private owners hold about 57 percent of the commercial forest land in the Puget Sound Area and the balance (43 percent) is held by public agencies. In general, private lands tend to be located at lower elevations and near Puget Sound. The National Forest commercial forest land is located at the higher elevations in the Olympic and Cascade Mountain

PHOTO 13. Current forest management practices include patch cutting. In the first half of this century, timber was easily accessible from Puget Sound, and forests were heavily cut over in areas nearest the shoreline. These low elevation lands are now stocked with young-growth forest. At the higher elevations, especially in the Cascade Range and to some extent in the Olympic Range, forests consist mainly of old growth timber. Seattle Times Photo.

Ranges. The following Table 1-32 presents the ownership classification of productive commercial forest land by Division.

Of the total commercial forest land in the Puget Sound Area about 55 percent (2.7 million acres) consists of sawtimber stands; 31 percent (1.6 million acres), poletimber stands; 13 percent (600,000 acres), sapling and seedling stands and the one percent balance (69,000 acres) is not stocked.

The Puget Sound Area has 101 billion board feet of sawtimber (International 1/4 -inch rule), and a large part of this volume is concentrated in the foothills and at the higher elevations of the Cascade Range. The Central Division has 57 percent of the

TABLE 1-32. Puget Sound Area. Ownership of productive commercial forest land, December 1968 (in thousand acres)

	Ownership			
Division	National Forest	Other Public	Private	Total
North	411	294	751	1,456
Central	667	390	1,578	2,635
West	216	155	542	913
Total Puget Sound Area	1,294	839	2,871	5,004

Source: Exhibit B, Table 5.

sawtimber volume; the North, 29 percent; and the West, 14 percent. Douglas Fir accounts for the largest share of the softwood sawtimber volume in the Puget Sound Area 35 percent. The proportion of western hemlock volume is nearly as great (32 percent), followed by the true firs (26 percent). Other softwoods such as white pine, lodgepole pine, and western red cedar account for 7 percent of the Area's softwood sawtimber volume. The hardwood sawtimber volume in the Puget Sound Area is 4.7 billion board feet or nearly 5 percent of the Area's total sawtimber volume. Red alder is the major hardwood species in the area, and accounts for 64 percent of the hardwood sawtimber volume.

Differences in the way forest lands have been utilized in the past are reflected in the sawtimber inventory. Because of early liquidation of the old growth on the private and other public lands, sawtimber volumes per acre on these lands are much lower on the average than those on National Forest lands. Thus, private forests, which account for over half of the area in the basin, support only about a third of the sawtimber inventory, 34.9 billion board feet. National Forests have most, 51 percent, of the Area's sawtimber inventory (51.6 billion board feet) on slightly more than one-quarter of the forest area. Other public agencies have 14 percent of the sawtimber (14.4 billion board feet) on 17 percent of the commercial forest land. The following Table 1-33 shows the species and volume of growing stock and sawtimber on available productive commercial forest land in the Puget Sound Area and Division as of 1968.

In the first half of this century the objective of forest management in the Puget Sound Area was essentially to remove the large, old-growth timber. The inventory volume became smaller and smaller as the accumulated growth of hundreds of years was harvested. Since a large amount of the old growth has been felled, the decline in inventory volume will be slower in the future than in the past. During the period 1968, to 2010, inventories of sawtimber in the Puget Sound Area will decline 16 percent. In 2020, this inventory is expected to 84,760 million board feet (International ¼-inch rule). It was estimated to 100,850 million board feet in 1968. The following Table 1-34 shows the change in inventory volume on commercial forest land by ownership.

TABLE 1-34. Puget Sound Area. Inventory volume on commercial forest land (1963-2020)

Owner	1963	2020	Change
	(MMBF, Int. ¼-inch rule)		(Percent)
National Forest	51,560	28,874	-44
Other Public	14,380	25,165	+75
Private	34,910	30,721	-12
Total Puget Sound Area	100,850	84,760	-16

Source: Exhibit B.

TABLE 1-33. Volume of growing stock and sawtimber on commercial forest land in the Puget Sound Area by species and division, December 1968

Species	Division North	Central	West	Total
Growing stock	Million cubic feet			
Douglas fir	1,285	3,258	1,579	6,122
Western hemlock	1,694	3,664	678	6,036
True firs	2,206	2,241	130	4,577
Sitka spruce	46	33	2	81
Other softwoods	679	1,449	255	2,383
TOTAL	5,910	10,645	2,644	19,199
Red alder	425	727	210	1,362
Other hardwoods	176	252	60	488
TOTAL	601	979	270	1,850
ALL SPECIES	6,511	11,624	2,914	21,049

Species	Division North	Central	West	Total
Sawtimber	Million board feet, International ¼-inch rule			
Douglas-fir	6,021	18,948	8,630	33,599
Western hemlock	9,028	18,609	3,342	30,979
True firs	11,138	13,320	846	25,304
Other softwoods	1,970	3,975	343	6,288
TOTAL	28,157	54,852	13,161	96,170
Red alder	952	1,667	400	3,019
Other hardwoods	513	958	191	1,662
TOTAL	1,465	2,625	591	4,681
ALL SPECIES	29,622	57,477	13,752	100,851

Inventory reductions will continue to take place with the continued harvesting of the large, mature and overmature timber. The National Forests with the largest backlog of old-growth timber will reduce their inventory by 44 percent. Private owners are expected to reduce their inventory by 12 percent, while the other public owner's sawtimber inventory will increase 75 percent by 2020. These inventory changes are based on projections for Western Washington, and it is assumed that they are representative of the conditions in the Puget Sound Area.

In the Puget Sound Area, net annual growth is projected to increase from 376 million cubic feet in 1963 to 467 million cubic feet in 2020. Under the assumptions made, net annual growth generally increases to the year 1990, and then levels off as growth and cut come more into balance. The projected increments in growth reflect the large increases in growth rates experienced, especially on the public lands, with the reduction of old-growth stands and the substitution of faster growing young trees.

Production, Output and Consumption

The forest industry of the Puget Sound Area is described in terms of log production, timber products output and consumption. In 1925 Washington was the Nation's leading State in log and lumber production, and most of this production came from Western Washington. About one-half of Western Washington's timber harvest came from the Puget Sound Area in that same year.

Log production in Western Washington has been through major changes since 1925. In 1929 production of timber west of the Cascade Range hit an all time peak of 8.2 billion board feet. During the depression, demand for timber declined and by 1932 log production had dropped to 2.5 billion board feet. During the period 1933-63, log production ranged between 3.6 and 5.6 billion board feet depending on fluctutations in business conditions. Western Washington's log production increased in recent years to 5.4 billion board feet in 1963, and in 1964 it reached its highest point since 1929 6.6 billion board feet. Log production in the Puget Sound Area has behaved, in general, like Western Washington's, although its share of the Western total declined from about 51 percent in 1925 to 36 percent in 1950 and to 34 percent in 1963. Log production in the Puget Sound Area remained essentially level during the 1950-63 period; however, there were substantial shifts in the suppliers of logs. In 1950, private owners supplied 80 percent of the total log harvest in the Puget Sound Area, whereas in 1963 they accounted for 54 percent. Production from private land decreased 29 percent during this 14-year period, while production from all public lands increased 138 percent.

National Forests had the greatest absolute increase in log production in the Puget Sound Area between 1950 and 1963. A 110 percent increment in timber harvest reflected both the increasing demand for timber in the area and the recalculation of allowable cut levels based on higher utiliztion standards and updated forest statistics. Other public timberland had the greatest relative increase (251 percent) and a large part of this increment of 176 million board feet reflects intensive management of State-owned lands by the Department of Natural Resources since the mid-1950's.

The manufacture of forest products in the Puget Sound Area remains important locally and nationally. Since the 1920's the forest economy has diversified to become important in veneer and plywood production, pulp and paper production, and at the same time maintain a significant lumber industry. The following Table 1-35 shows the output of timber products in the Area as of 1963.

TABLE 1-35. Puget Sound Area. Output of timber products 1963

Division	Lumber 1000 bd ft.	Plywood 1000 sq. ft.	Misc. Products 1000 cu. ft.	Woodpulp Tons
North	111,200	210,000	11,900	186,200
Central	910,700	941,700	48,400	838,300
West	302,900	105,000	14,800	496,700
Total Puget Sound Area	1,324,800	1,256,700	75,100	1,521,200

Source: Exhibit B, Table 11.

Area plywood production in 1963 represented 12 percent of the national softwood, plywood production and 67 percent of the production of the State. Woodpulp production was 5 percent of the National total. The production of lumber in the Area was 4 percent of U.S. production and 37 percent of the lumber sawn in the State of Washington in 1963.

The Forest Service reports, "Timber Trends in the United States" and "Prospective Economic Devel-

opments Based on the Timber Resources of the Pacific Northwest," show that a substantial share of the future national demand for timber will be for the kind of large, high-quality softwood timber found in Western Washington and processed in the Puget Sound Area. Increasing national demand for pulp and paper products will, in turn, create more demand in the future for wood fiber by the basin's large paper and allied products industry, bringing about more intensive utilization of cull logs, young-growth and mill residue. Only a small part of the output in Western Washington and the Area is consumed locally, with most of it going to national markets. The forest industry in the Puget Sound Area is highly developed and diversified, therefore it is expected that it will continue to serve national markets in the future. Under these conditions, it is assumed that all of the economically available supply of timber in the Area will be easily absorbed by the growing demands of the Nation and also by the more immediate demands of the Pacific rim countries. Thus, the available supply of timber in Western Washington is the key to the future forest economy of the Puget Sound Area.

The projections of future available timber supply are based on the planned allowable cuts on public lands and on the trends of past cutting on private lands. Future harvests are modified by the effects of such cutting on growth and inventory. The estimate of total available volume includes live, sound trees, and the usable portions of cull and dead trees. Log movements in the Pacific Northwest are included in the projection as well as net log exports. These projected volumes then represent the total volume of roundwood available for consumption by the forest industries.

In the projections of wood consumption for the Puget Sound Area, it was assumed that the relative distribution of the various manufacturing processes among the division would not change from the 1963 base. Trends toward increasing utilization of small logs, decreasing mortality, and changes in volume and use of residue were also considered in projecting future wood consumption to the year 2020.

Total wood consumption in the Puget Sound Area is expected to increase from 647 million cubic feet in 1965 to 931 million cubic feet in 2020. However, wood consumption is projected to increase until 2010 after which a slight decline is expected to the year 2020. The use of residue will increase in the future. In 1965, residues made up 20 percent of the total wood consumed in the Puget Sound Area. In 2020 this portion of total consumption is projected to be 35 percent. Thus, increasing use of residue is an important factor in achieving a large increment in wood consumption during the projection period as is indicated on the following Table 3-15.

The amount of lumber produced per cubic foot of saw log consumed will decline in the Puget Sound Area in the future due to the use of smaller trees. As a result, although cubic-foot saw-log consumption increase, the board-foot volume actually will decline 47 percent between 1965 and 2020. In 1965, it was estimated that 1,434 million board feet of lumber were produced, whereas in 2020 it is expected that 766 million board feet of lumber will be produced. This trend in output of lumber in the basin is counter to the forecast of national trends.

TABLE 1-36. Puget Sound Area. Wood Consumption by source and use 1965-2020 (million cubic feet)

Year	Total wood consumption	Saw log[1]	Veneer log	Pulp wood[2]	Miscellaneous products	Log exports
1965	647	232	93	241	22	59
1980	814	178	122	342	30	142
2000	956	185	156	499	36	80
2020	931	155	179	546	31	20

[1] *Includes peeler cores.*

[2] Includes chips from slabs and edgings, sawdust, and other mill residue used in pulping.

Source: Exhibit B, Table 13.

By the year 2000, national veneer log consumption will nearly triple while the Area's consumption will only double. Like the rest of the Pacific Northwest, the Puget Sound Area's veneer and plywood industry is not expected to grow quite as rapidly as national demand because of the development of the softwood veneer and plywood industry in the south. As shown in Table 1-36 above, veneer log consumption in the Puget Sound Area amounted to 93 million cubic feet in 1965. Consumption is expected to be 156 million cubic feet in the year 2000 and increase to 179 million cubic feet in 2020.

Consumption of pulpwood in both the Puget Sound Area and the Pacific Northwest is expected to increase more than the national average. The proximity of sawmills, plywood plants, and pulpmills to each other in the Puget Sound Area has made mill residues a relatively low cost raw material for the pulp industry. The waters of Puget Sound have made it feasible to transport large volumes of residue to the pulpmills at low cost. Estimated total consumption of wood fiber by the pulp and paper industries in the Puget Sound Area was 241 million cubic feet in 1965. This is expected to increase to 342 million cubic feet in 1980, 499 in 2000 and 546 million cubic feet in 2020. Production in the Central Divison is expected to dominate the Area production. A large proportion of the residue consumed in the future will come from areas which lie outside the Study Area.

The national projections show that little increase is expected in the use of miscellaneous wood products such as poles, pilings, fence-posts, and fuelwood; projections for the Pacific Northwest and the Puget Sound Area follow these same national trends. However, the miscellaneous wood products category includes log exports. Log exports are expected to fluctuate widely with changes in international economic conditions, and therefore the Area's projections for the miscellaneous wood products show the Area's expected response to international demand for roundwood.

Employment

Employment in the lumber and wood products industry was about 13 percent of total manufacturing employment in the twelve county area in 1963. For the Nation this sector of manufacturing employment was only 3.5 percent.

Exhibit B provides forest industry employment data as of 1964 based on information from the Employment Security Department of the State of Washington. A synopsis of this data is shown in the following Table 1-37 and indicates that 67 percent of the employees were employed in the Central Division, 21 percent in the West Division, and 12 percent in the North Division.

TABLE 1-37. Puget Sound Area. Forest products employment by division 1964

Industry	North	Central	West	Total
Logging (SIC 2411)	680	2,020	500	3,200
Sawmills and Planing Mills (ISC 2421)	420	5,130	920	6,470
Veneer and Plywood Plants (ISC 2432)	710	3,610	1,940	6,260
Misc. Lumber & Wood Products (Balance of SIC 24)	610	3,320	380	4,310
Paper & Allied Products (SIC 26)	1,040	6,030	2,490	9,560
Total	3,460	20,110	6,230	29,800

Source: Exhibit B, Table 12.

The lumber and wood products industries in the Puget Sound Area import large quantities of raw materials from other areas in the State of Washington. Consequently, employment projections depend greatly on the availability of wood from outside the Area.

The projections of employment for lumber and wood products vary in the reports prepared by Consulting Services Corporation (Exhibit D) and the report prepared by the Forest Service, U. S. Department of Agriculture (Exhibit B). The Study Area and statistical methods used for projecting the future of lumber and wood products in the Puget Sound Area were different for each report and consequently the projections vary. A comparison of these differences is shown in Table 1-38. The projections made by the Forest Service were used for planning purposes in the Comprehensive Water Resource Study of Puget Sound and Adjacent Waters.

The projections made by the Forest Service indicate a 30 percent decline in total forest industry employment between 1965 and 2020. Consulting Services Corps projects a 54 percent decline. The following Table 1-38 shows employment in the lumber and wood products industries for the period 1965-2020 in the Puget Sound Area.

TABLE 1-38. Puget Sound Economic Area. Employment Projections.

Industry	U.S. Forest Service 1965-2020[1] 1965	1980	2000	2020
Logging	4,500	3,900	3,200	2,400
Sawmills & Planing Mills	6,500	3,100	2,100	1,300
Veneer & Plywood Mills	6,100	5,600	5,000	4,500
Miscellaneous	4,400	4,400	4,400	4,400
Paper & Allied Products	9,800	10,300	10,900	9,300
Total	31,300	27,300	25,600	21,900
	Consulting Services Corp[2] 1963	1980	2000	2020
Lumber & Wood Products	19,700	8,300	2,800	900
Paper & Allied Products	9,400	14,700	15,900	12,400
Total	29,100	23,000	18,900	13,300

[1] Source: Exhibit B, Table 16.

[2] Source: Exhibit D, Table 1-4.

Based on the U. S. Forest Service projections the total lumber and wood products industry employed 21,500 workers in 1965 and employment is expected to drop 41 percent by 2020 to 12,600. Of this category sawmill and planning mill employment will drop the most–80 percent. Paper and allied products employment is expected to remain stable over the study period. Total employment is projected to increase rapidly between 1965 and 1990 and remain relatively stable at 10-11,000, until 2010 and decline to about 9,300 in 2020.

MINERALS

General

Major objectives of Exhibit C, Economic Aspects of the Mineral Industry in the Puget Sound and Adjacent Waters Area, are to present the record of mineral production, describe the type and location of major mineral resource deposits in the Area, identify the economic and technologic influences on the mineral industry within the Area, and project the activity of the minerals industry within the Study Area for the years 1980, 2000 and 2020.

Mineral production values for the Puget Sound Area have ranged from \$23.9 million in 1955 to \$35.5 million in 1964, which is less than 1 percent of national mineral production values as shown on Table 1-39.

Although total mineral production values for the Area cannot be published each year, to avoid disclosing individual company confidential information, the Area in the past decade has accounted for between 36 and 44 percent of the mineral production value in the State. The Puget Sound Area accounted for about 44 percent of the State mineral production value in 1964. Throughout the period 1955-64, five counties have led in terms of mineral production value. The counties, in order of descending value, are King, Whatcom, Pierce, Skagit, and Snohomish. On the average, mineral production value from the other seven counties amounts to less than \$500,000 for each county annually and is confined largely to output of common construction materials, such as sand and gravel and stone.

Production of minerals and manufacture of mineral products for the Puget Sound Area approximates \$741 million. Although Bureau of Mines records for metals, coal, and cement are complete from early 1900, information before 1933 is sparse for the other nonmetals. Nevertheless, non-metals have accounted for \$527.6 million, or 70 percent of the total recorded mineral production value. Coal and peat, at \$216.4 million comprise 29 percent of the total, and metals, at \$7 million, were less than 1 percent of the total recorded value.

Cement, coal, sand and gravel, and stone stand out as dominant materials produced and comprise over 96 percent of the total recorded mineral production values in the Area.

Several commodities, such as clay, lime, silica sands, olivine, talc, copper, gold and manganese, have contributed significantly to the total minerals value and will possibly share in the future economic contributions to the Area.

Compiling production of minerals by decade shows that construction materials, such as cement, sand, and gravel, and stone, are increasing in output. Progressive increase also show for lime, olivine, and silica. Output of clays and talc has declined from the high rates of production established during the period 1910-19.

For metals, production of gold was highest during the depression years, copper was mined extensively in the late 1920's, and manganese output was greatest during World War II.

TABLE 1-39. Puget Sound Area. Value of mineral production by county, 1955, 1960, 1964. (thousand dollars)

County	1955	1960	1964	Minerals Produced in 1964 in Order of Value
Clallam	$ 253	$ 88	$ 231	Sand and gravel, stone.
Island	109	220	72	Stone, sand and gravel.
Jefferson	W	457	W	Stone, sand and gravel.
King	9,151	7,805	12,826	Cement, sand and gravel, stone, coal, clays, peat.
Kitsap	133	282	372	Sand and gravel, stone, peat.
Mason	W	W	234	Stone, sand and gravel.
Pierce	2,502	3,290	4,327	Sand and gravel, lime, stone, clays, peat.
San Juan	W	156	W	Sand and gravel, stone.
Skagit	W	3,053	4,108	Cement, olivine, sand and gravel, stone, soapstone, peat.
Snohomish	1,359	1,938	3,358	Sand and gravel, stone, peat, clays.
Thurston	387	267	347	Sand and gravel, coal, stone, peat.
Whatcom	W	W	W	Cement, stone, sand and gravel, olivine, clays.
Total Combined Counties	$23,928	W	$35,551	
State Total	$67,334	$72,404	$80,977	
% of State Total	36%	W	44%	
National Total (million dollars)	$15,792	$18,032	$20,472	

W—withheld to avoid disclosing individual company data.
Source: *Minerals Year Book*, U.S. Department of Interior, Bureau of Mines.

The map shown on Figure 1-7 and accompaning list shows the location of 7 mineral processing and related industrial facilities as of 1964 in the Puget Sound Area.

Future production of selected minerals was estimated for the area. These estimates were based on a trend line established from historical records and projected by standard regression technique.

Estimated mineral production in the Area from 1980 to 2020 is shown in Table 1-40. Discussions are given for expected requirements of each commodity listed.

TABLE 1-40. Puget Sound Area. Estimated Mineral Production (1964-2020)

	1964	1980	2000	2020
Cement (million barrels)	4.3	5.5	9.0	14.0
Clay (1000 tons)	107.0	125.0	150.0	175.0
Lime (1000 tons)	47.0[1]	70.0	100.0	175.0
Peat (1000 tons)	35.0	50.0	60.0	70.0
Sand and gravel (million tons)	12.4	15.0	25.0	35.0
Stone	3.5	5.0	8.0	10.0

[1] Estimated consumption.

Source: Exhibit C, Table 33.

Nonmetals

Cement In the Puget Sound Area, cement is produced by Lone Star Cement Company at Seattle, by Columbia Cement Company (formerly Kaiser Cement & Gypsum Corp.) at Bellingham and by Ideal Cement Company at Seattle. There are two other cement plants in the State, one in Pend Oreille County and one in Spokane County.

Cement data for the State of Washington have been combined with Oregon figures in the past to avoid disclosing information concerning Oregon producers; therefore, past production data cannot be given for the State of Washington. Production of cement from the four plants in the Area can be shown historically without revealing individual plant data in Oregon and Washington, and production figures for the four plants in the Area are shown in Table 1-41.

TABLE 1-41. Puget Sound Area. Production of Cement, 1950-1964

Year	Quantity (376-pound barrels)	Value
1930	2,823,354	NA[1]
1940	2,879,096	NA
1950	3,223,513	$ 8,559,812
1955	3,783,517	12,007,528
1960	3,815,359	13,305,679
1964	4,291,717	15,721,047

[1] NA—Not Available

Source: Exhibit C, Table 6.

Cement firms operate distribution centers, including storage silos for bulk cement to service local markets; some large users, such as ready-mixed concrete companies, have similar storage facilities. Cement is distributed to consumers in the Puget Sound Area and the State of Washington and surrounding areas from the four operating plants and from three distribution terminals. In 1964 about 1 million barrels of cement produced in the Area was shipped to consumption points in other parts of Washington and outside the State. Shipments of Portland cement by Washington producers by type of customer in 1964 was 58.6 percent to ready-mixed concrete companies, 11.5 percent to concrete produced manufacturers, 5.2 percent to building material dealers, 13.5 percent to highway contractors, 10.5 percent to other contractors, and less than 1 percent to Federal, State and local government agencies.

Transportation cost restrains the volume of imports and exports, limits the market area of the individual plant, and plays a major role in governing the movement of cement within an area and from one area to another. In 1964, 84 percent of the cement produced in the Area was transported by truck, 14 percent was shipped by rail and 2 percent was moved by boat. In 1964, over 88 percent of cement shipments in the Puget Sound Area were in bulk, and the remainder was in paper bags. Specially designed self-unloading trucks, railroad cars, ships and barges are used to move bulk cement. Labor costs have been reduced by use of higher capacity machinery combined with centralized controls with electronic or automatic equipment. Estimated labor cost for producing cement in the Puget Sound Area in 1964 was 62 cents per barrel.

Consumption of cement in the Puget Sound Area, shown in Table 1-42 was estimated from the State per capita figures. About 85 percent of the cement consumed in the Area is within the Central Division, and an estimated 75 percent is used in manufacturing concrete products such as ready-mixed concrete.

TABLE 1-42. Puget Sound Area. Estimated Consumption of Cement, 1950-1964 (thousand 376-pound barrels)

Year	Central	North	West	Total Puget Sound Area
1950	2,117	220	175	2,510
1960	2,995	285	220	3,500
1964	2,925	725	215	3,415

Source: Exhibit C, Table 8.

Future estimates of cement production in the Puget Sound Area are based on projected commercial sand and gravel production in the Area which averaged 2.5 percent annually. The average annual production increase of 2.5 percent indicates per capita consumption requirements of about 2 barrels of cement in the Area throughout the period of this study, or per capita requirements of 1.96 barrels in 1980, 2.05 barrels in 2000, and 1.97 barrels by 2020.

The trend in the Puget Sound Area is toward reducing labor costs and cement prices by installing

MINERAL PROCESSING AND RELATED INDUSTRIAL OPERATIONS—1964

Cement
1 Kaiser Cement & Gypsum Corp.
2 Lone Star Cement Corp.
3 Lone Star Cement Corp.
4 Lone Star Cement Corp.
5 Ideal Cement Co.
6 Kaiser Cement & Gypsum Corp.
7 Ideal Cement Co.

Lime
8 Pacific Lime, Inc.

Aluminum
9 Kaiser Aluminum & Chem. Corp.
10 Intalco Aluminum Corp.

Copper (& byproduct sulfuric acid)
11 American Smelting & Refining Corp.

Ferroalloys
12 Ohio Ferroalloys Corp.

Steel
13 Bethlehem Steel Co., Pac. Coast Div.
14 Northwest Steel Rolling Mills, Inc.
15 Isaacson Iron Works

Petroleum
16 Mobil Oil Co., Inc.
17 Shell Oil Co.
18 Texaco, Inc.
19 Union Oil Co. of California
20 U.S. Oil & Refining Co.

Sulfuric acid
21 General Chem. Div., Allied Chem. Corp.

Chlorine
22 Georgia Pacific Corp.
23 Hooker Chem. Corp.
24 Pennsalt Chemicals Corp.

Glass
25 Northwestern Glass Co.

Gypsum
26 Kaiser Cement & Gypsum Corp.

Clays
27 Builders Brick Co.
28 Builders Brick Co.
29 Builders Brick Co.
30 International Pipe & Ceramic Corp.
31 International Pipe & Ceramic Corp.
32 International Pipe & Ceramic Corp.
33 International Pipe & Ceramic Corp.
34 International Pipe & Ceramic Corp.
35 Lowell Brick & Tile Co.
36 Lynden Clay Products, Inc.

Coal
37 Coal, Inc.
38 Palmer Coking Coal, Inc.
39 Palmer Coking Coal, Inc.
40 Queen Coal Co.

Olivine
41 Northwest Olivine Corp.
42 Olivine Corp.

Silica
43 Smith Bros. Silica Sand., Inc.
44 Cavanaugh Molding Sand Co.

Talc and miscellaneous
45 Northwest Talc & Magnesium
46 Manufacturers Mineral Co.

Sand & gravel, 100,000-200,000 tons
47 Miles Co.
48 North Kitsap Gravel & Asphalt Co.
49 Olympia Oil & Wood Products Co.
50 Reid Sand & Gravel, Inc.
51 Stoneway Sand & Gravel Co.
52 Tim Corliss & Sons
53 Western Sand & Gravel Co.

200,000-500,000 tons
54 Associated Sand & Gravel Co., Inc.
55 Cadman Gravel Co.
56 Cascade Asphalt Paving Co.
57 Freeway Concrete Supply Co.
58 Holroyd Land Co., Inc.
59 Lakeside Gravel Co.
60 North Star Sand & Gravel Co.
61 Renton Sand & Gravel
62 Renton Sand & Gravel

Over 500,000 tons
63 Boise Cascade Corp., Klinker Div.
64 Friday Harbor Sand & GravelCo.
65 Glacier Sand & Gravel Co.
66 Pioneer Sand & Gravel Co.

Stone, 100,000-200,000 tons
67 Associated Sand & Gravel Co., Inc.
68 Black River Quarry, Inc.
69 Woodworth & Co., Inc.

200,000-500,000 tons
70 Associated Sand & Gravel Co., Inc.
71 General Construction Co.
72 Kaiser Cement & Gypsum Corp.
73 Lone Star Cement Corp.
74 Puget Sound Bridge & Dry Dock Co.

Numbers refer to Figure 1-7

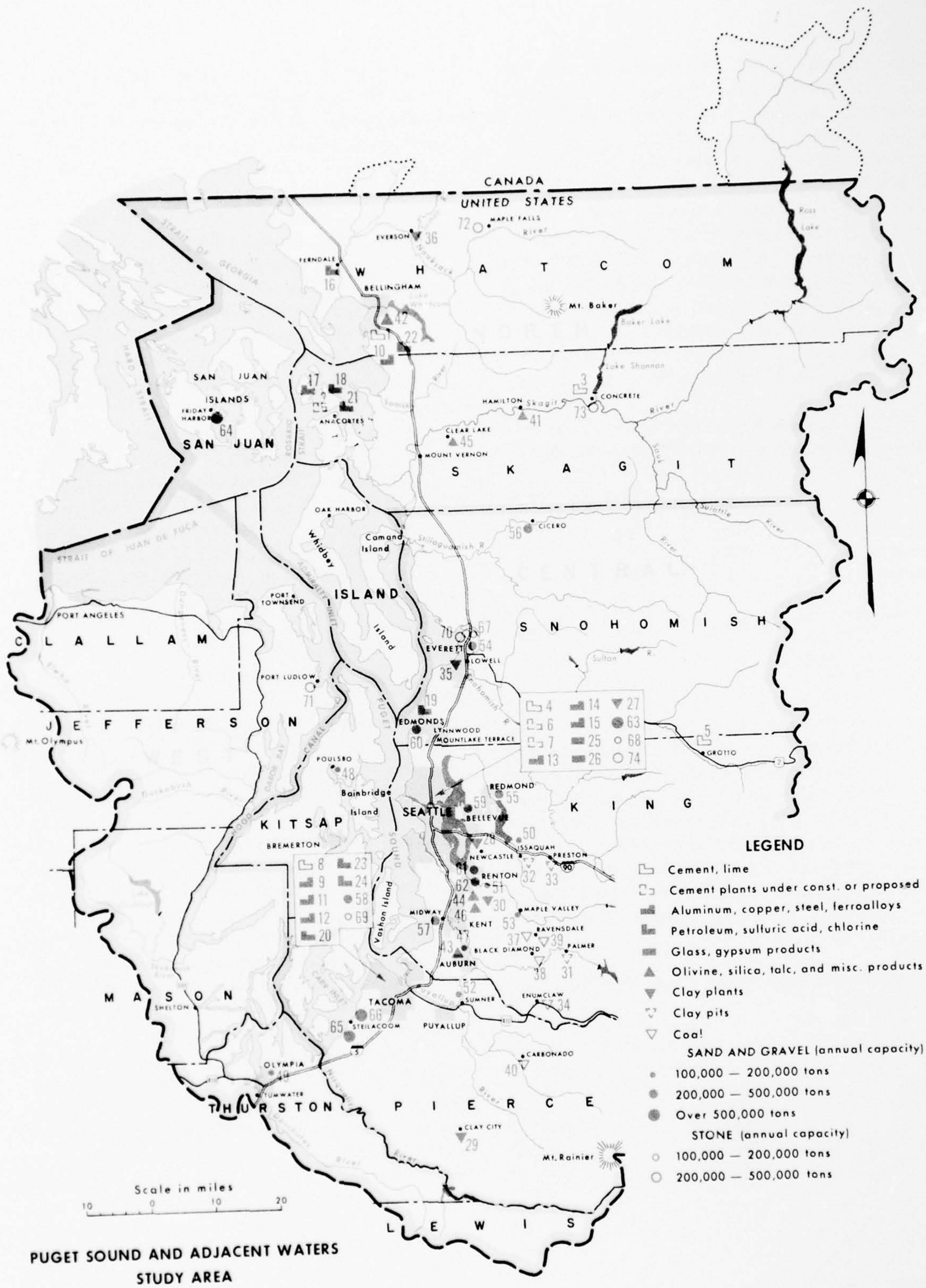


FIGURE 1-7. Mineral processing and related industrial operations, 1964

larger capacity plants and production machinery combined with centralized controls with electronic or automatic equipment. Firm commitments to install highly efficient cement producing capacity of 8.5 million barrels annually have been made by companies operating in the area. This proposed additional capacity will be sufficient to fulfill needs of the Area until 2000 and possibly to 2020, if existing plants in the Area remain in operation. However, as new capacity is completed, some older obsolescent high-cost production plants will be deactivated or revamped with automated equipment.

Estimated consumption of Portland cement from 1980 to 2020 is shown in Table 1-43.

TABLE 1-43. Puget Sound Area. Estimated consumption of Portland Cement, 1980-2020 (million barrels)

Division	*1980*	*2000*	*2020*
Central	4.8	7.9	12.4
Northern	0.4	0.6	0.9
Western	0.3	0.5	0.7
Total Puget Sound Area	5.5	9.0	14.0

Source: Exhibit C, Table 34.

Clay—*Fire clay and miscellaneous clay are the* only types produced in the Puget Sound Area. Fire clays are basically kaolinitic but usually include other clay minerals and both organic and inorganic compounds. Generally, fire clay indicates use for refractories. The term miscellaneous clay does not refer to any recognized grade, although such clay may sometimes be referred to as common, brick, sewer pipe, or tile clay. Total production of clays in the Area is shown on Table 1-44.

TABLE 1-44. Puget Sound Area. Clay Production, 1948-1964.

Year	Short Tons	Value
1948	82,908	$ 76,372
1950	78,967	77,846
1952	131,973	146,712
1954	105,224	142,233
1956	143,387	189,299
1958	154,814	174,546
1960	128,247	145,850
1962	80,787	90,840
1964	106,752	126,297

Source: Exhibit C, Table 10.

In 1964, the bulk of clay production was from King County but some was also produced in Pierce, Snohomish, and Whatcom Counties. The highest concentration of ceramic plants in the Pacific Northwest is in the vicinity of Seattle. Six manufacturing plants in the Seattle area produce structural clay products and refractories. The large and constantly increasing marketing area of King County makes it a *natural center of ceramic industry*. However, many clay mines near Seattle have been subject to zoning restrictions and have been closed. Additional sources of ceramic raw materials within the county will depend upon further prospecting in the coal-mine areas for shales suitable for making expanded aggregates.

Clays are mined for manufacturing cement in King, Skagit, and Whatcom Counties. Clays suitable for manufacturing structural clay products are widespread in Pierce County. A recent development has been the importing of clay material from California to the Seattle area. Quantities of imports are not available, but it is estimated that the difference between 1964 production of about 107,000 tons and 1957 production of 181,000 tons is made up of imports. Based on this assumption, imports to the Seattle area probably approximate 75,000 tons annually.

Transportation is a relatively small factor in the clay-processing industries. Most of the miscellaneous-clay and fire-clay processing plants obtain their supply of raw material from deposits adjacent to the plants. However, transportation is a major factor in marketing of brick, tile, lightweight aggregates, and other clay construction products. Only in special instances can the marketing radius exceed a few hundred miles.

Intense competition from other construction materials is threatening the structural clay products industry; in some cases, principal competing products, such as glass, metals, conventional and special concretes, are replacing clay brick and tile.

Fire-clay industries also are threatened by competition. In some local areas, high-grade fire-clay deposits are becoming exhausted. Competition from other refractories is increasing because of technological changes and because of higher maintenance and replacement costs involved with fire-clay products. Data are lacking on the quantities of clay and shale suitable for production of expanded lightweight aggregates and for other uses in the Puget Sound Area. Lack of adequate data on potential markets for

lightweight clay and shale aggregate prevents the optimum growth of the lightweight aggregate industry.

The trend of clay production in the Puget Sound Area for the period 1948-64 is increasing at an average annual rate of 3 percent. However, since 1957, output in the Area has declinad sharply because of clay imports from California. Therefore, growth estimates based on the regression statistical analysis for clay production in the Puget Sound Area are unrealistic. Future clay output in the Area is predicted upon anticipated brick consumption in the Pacific Northwest, increasing annually at a rate of 0.4 percent to 1985, coupled with expected consumption of clay in manufacturing cement. Predictions of total clay output in the Area imply an average annual increase of about 1 percent, or 175,000 tons, by 2020.

Lime–Lime is regarded as a basic industrial chemical and the starting material for a wide variety of chemicals. In the Pacific Northwest, it is used in the construction industry for finishing lime, masons lime, and for soil stabilization. Also, lime has wide application in the metallurgical industries where it is used in ore concentration, smelting, and refining copper and aluminum, and as a flux in steel making. Other major industrial uses of lime in the Pacific Northwest include the pulp and paper and beet sugar industries. The neutralization properties of lime permit its use for sewage and water treatment of industrial, municipal, and agricultural water wastes.

Lime production figures cannot be published for the State of Washington or for the Puget Sound Area because individual company data would be disclosed. However, some information is available for the Pacific Northwest. In 1964, over 390,000 short tons were produced in the Pacific Northwest of which about 110,000 tons were sold and the balance (280,000 tons) used in internal company production.

A Tacoma operation currently is the only lime producer in the State manufacturing lime for open-market sale. Small amounts of lime have been produced in the past from intermittent operations in King, Snohomish, and Whatcom Counties. Captive-lime plants in the State, where lime is manufactured by a specific industry for its own use, include operations at sugar refineries in Grant and Yakima Counties. Re-use of lime is customary in the pulp and paper industry. Reclamation plants recarbonate the used lime sludge, dewater it, and recalcine. Regenerated lime from pulp and paper operations accounts for a large part of the total lime production in the Puget Sound Area.

An estimated 350,000 tons of lime is regenerated annually at pulp and paper mills in the State, and a large share of this production is in the Puget Sound Area. Significant quantities are produced in captive operations for use in sugar refining. In the Puget Sound Area, an estimated 47,000 tons of lime is consumed annually exclusive of that recycled at pulp and paper mills. In addition to this, aproximately 140,000 tons or 40 percent of the State total recycled lime is regenerated annually for use at pulp and paper mills. Recycled lime production at pulp mills in the Puget Sound Area comes from operations of Crown Zellerbach Corporation, Port Townsend, St. Regis Paper Company, Tacoma, and Weyerhaeuser Company, Everett.

There are no alternate materials, within a comparable price range, to replace lime in its use as an alkaline reagent in manufacturing chemicals and in many industrial uses. Finely ground limestone has largely replaced lime in agricultural uses because it lasts longer in the soil and requires less frequent application. In building construction, gypsum plaster and wallboard have largely replaced the lime-sand plastered walls because of lower costs of installation. The use of lime for masonry mortars has declined because of utilization of cement for mortar.

Based on per capita lime consumption figures for the State of Washington, consumption of primary open-market lime in the Puget Sound Area could more than double over present consumption, or reach 100,000 tons by 2000. Additional lime plant capacity possible will be installed by that time to fulfill consumption trends. Advantages the Area holds for additional lime-producing facilities are nearness to high-calcium markets in the State, and tidewater location of transportation facilities. Estimates primary open lime consumption in the Area by 2020 are 175,000 tons annually.

Peat–The peat resources of the United States have been surveyed extensively, and known reserves are estimated at approximately 14 billion tons of air dried peat. Peat is found in 35 states in the United States; however, the principal deposits, or 90 percent of the reserves, are found in Minnesota, Wisconsin, Florida, and Michigan. Less than 1 percent of the total United States reserve, or an estimated 73 million tons, is in the Pacific Coast States of California, Oregon, and Washington. Peat reserves at active operations in Washington were estimated at 2 million

tons in 1964, or 2 percent of the total peat reserves at active operations in the United States. Of the 14 peat deposits in the State over 600 acres, nine are in the Puget Sound Area. Of the deposits with a maximum depth of over 400 feet, 19 of the 21 in the State are located in the Puget Sound Area.

Peat production in Washington in the period 1951-1964 ranged between 32,000 and 55,000 thousand tons. The value of this production ranged between $99,000 and $359,000. Most of the Washington production came from the Puget Sound Area. Peat moss and reed-sedge peat are the common types produced in the area, although some humus is removed. Output was from 15 operations, and King County led in peat production, followed by Snohomish, Thurston, Kitsap, Pierce, and Skagit Counties. Humus, peat moss, and red-sedge peat were produced, and most was sold in bulk. Before 1955, most domestic peat was sold locally in bulk because low-cost packing materials had not yet been developed. With the advent of synthetic films, inexpensive moisture-proof containers became available, and large quantities of domestically produced peat are now packaged and distributed to all parts of the United States. In the Puget Sound Area, bulk peat usually is sold locally directly to consumers by the producer. Virtually all the peat consumed is used for agricultural and horticultural purposes.

The outlook for the peat industry is expected to be one of continued growth. Since 1945, the number of producers in the United States has more than doubled, and domestic output has increased more than fivefold. Consumption in the Puget Sound Area should continue upward, because peat is in demand by homeowners, landscape gardeners, nurseries, and greenhouses in most parts of the Area, particularly in urban and suburban areas. Future output, expected to reach 50,000 tons by 1980, is projected from past production trends and implies reserve requirements of the magnitude of about 3.5 million tons by 2020.

Sand and Gravel The terms consumption and production are used interchangeably for sand and gravel as stocks are relatively small and constant. Sand and gravel production is divisible into two main classes: commericial production which is sold on the open market and Government-and-contractor production, which is produced exclusively for use on Federal, State, county, or municipal projects. Sand and gravel production in the Puget Sound Area for the period 1950-1964 is delimited by commercial and Government-and-contractor (non-commerical) operations in Table 1-45.

TABLE 1-45. Washington and Puget Sound Area. Sand and gravel production 1950-1964, (thousand short tons)

Year	Puget Sound Area Commercial	Noncommercial	Total	State of Washington Total
1950	NA	NA	4,173	10,606
1955	4,984	1,905	6,889	21,645
1960	6,810	1,862	8,672	25,594
1964	9,863	2,494	12,357	31,920

NA—Not Available

Source: Exhibit C, Table 14.

The largest amount of sand and gravel production in the Area is in the Central Division and for the period 1960-1964 output was over 80 percent of the Area total. Most of the production in the Central Division is from commercial operations.

Combined output of sand and gravel from the North and West Divisions for the past five years has been less than 20 percent of the Area total. The material from these divisions has been largely from Government-and-contractor operations and used mostly for roads.

Per capita consumption of sand and gravel aggregates in Washington, ranging from a low of 3.5 tons in 1943 to a high of 13.7 tons in 1964, is compared from 1940 to 1964 with United States figures, which have ranged from a low of 2.6 tons in 1944 to a high of 8.3 tons in 1964. The reason that Washington per capita figures are higher than the national average is that the ratio of sand and gravel from Government-and-contractor operations in Washington is greater than the national figure. The ratio of sand and gravel going into road construction and at dam building projects is greater for Washington than the national average.

The largest plants in the State, or all operations producing over 500,000 tons annually, are in the Puget Sound Area. Most, or 82 percent of the sand and gravel production in the Area, came from stationary plants. The remaining 18 percent came from a number of portable and semi-portable operations throughout the Area.

Because of the relatively low-unit value of sand and gravel, deposits are seldom surveyed in depth to

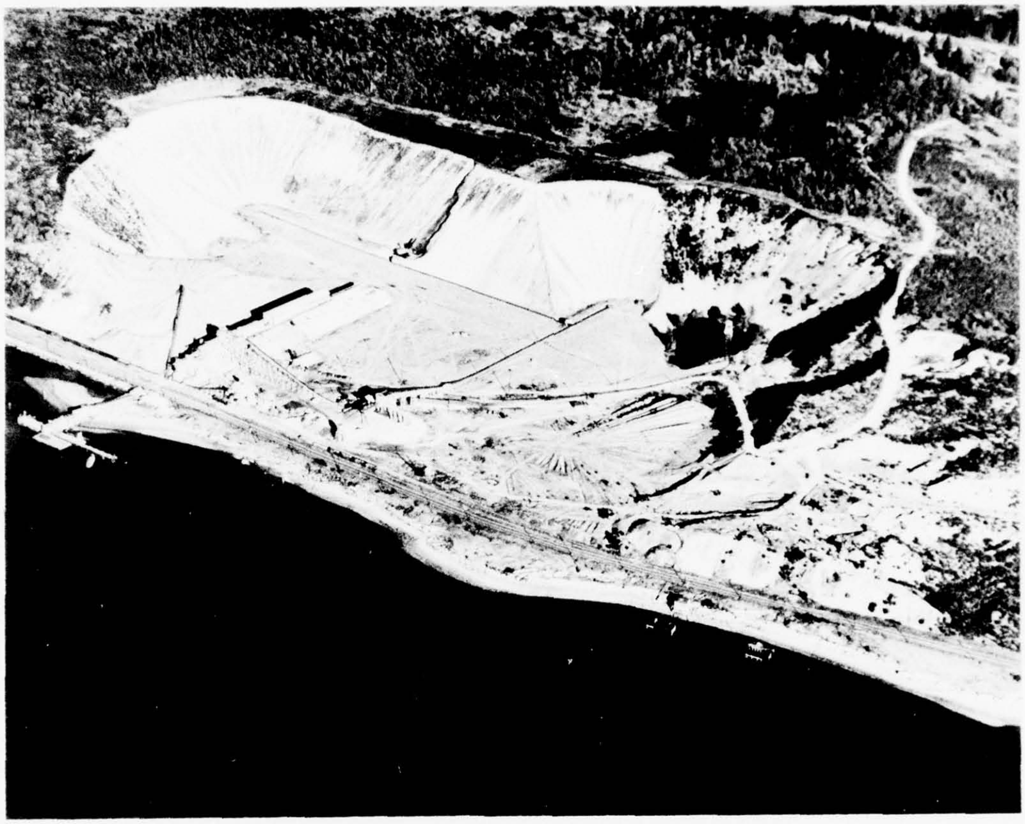


PHOTO 14. Pioneer Gravel Pit near Tacoma has provided construction material for such major landmarks as the Seattle Civic Auditorium, Lake Washington Floating Bridge, Aurora Bridge, dry docks at Puget Sound Naval Shipyard in Bremerton, as well as many warehouses and piers. Due to the relatively low unit value of sand and gravel, deposits are seldom surveyed in depth to determine reserves. As a result, few measures have been taken toward conservation as the supply generally has been considered adequate except for deposits near large cities. In the realm of land use planning, extraction of sand and gravel before such deposits are lost forever by covering them with buildings has been receiving some consideration. With limited supplies near urban areas, transportation costs could make sand and gravel an expensive commodity in the future. Seattle Times Photo.

production of pulp and paper products, the two most

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determine reserves. As a result, few definite measures have been taken toward conservation as the supply generally has been considered adequate except in deposits near large cities. Indirectly, a measure of conservation results from use of portable plants capable of mining small, scattered deposits near points of application. Little or no regard has been given to the various ideas advanced for multiple land use for sand and gravel deposits. However, in the realm of land-use planning, extraction of sand and gravel before such deposits are lost forever by covering them with buildings has been receiving some consideration. With limited supplies near urban areas, transportation costs could make sand and gravel an expensive commodity in the future. Estimated per capita requirements for aggregates in the Puget Sound Area for the project; period of this study are 5.8 tons in 1980, 5.7 tons in 2000 and 4.9 tons in 2020.

Projections of production of sand and gravel by division are shown in the following Table 1-46.

TABLE 1-46. Puget Sound Area. Sand and gravel production 1980-2020, (million tons)

Division	1980	2000	2020
North	1.1	1.8	2.4
Central	13.0	21.9	30.9
West	0.9	1.3	1.7
Total	15.0	25.0	35.0

Source: Exhibit C, Table 37.

Stone

The term "crushed and broken stone" is applied to irregular fragments of rock crushed or ground to smaller sizes after quarrying. Classification terms, such as traprock, granite, and miscellaneous stone are used in the broadest sense in the crushed stone industry. In the Puget Sound Area crushed basalt (traprock) has been the predominant type both in tonnage and value of production. This is followed by crushed limestone which is used for manufacturing cement and lime.

Stone production, as with sand and gravel, is divisible into two main classes: commercial production and Government-and-contractor production. Basalt or traprock accounted for 75 percent of the stone produced in 1964, and 24 percent of the traprock was from Government-and-contractor operations. The remaining 25 percent of the stone produced was largely limestone for manufacturing cement; some granite, marble, dimension sandstone, and miscellaneous stone were produced, largely for building purposes.

Stone usage in 1964 in the Puget Sound Area is shown in Table 3-26. The area accounted for 34 percent of the stone produced in the State during that year. Concrete aggregate and roadstone are the major uses for stone in the Puget Sound Area consuming 62 percent of the total in 1964. Output of stone for this use was greatest in the Central economic subarea.

TABLE 1-47. State of Washington and Puget Sound Area. Stone usage 1964, (thousand short tons and thousand dollars)

Use	Puget Sound Total Quantity	Puget Sound Total Value	State Total Quantity	State Total Value	Percent of State Total
Building dimension	29	$ 258	W[2]	W[2]	28
Concrete & roadstone	2,141	3,253	7,709	9,745	28
Riprap	483	777	1,080	1,365	45
Other	831	1,649	1,488	3,761	56
Total[1]	3,484	$5,937	10,276	14,871	34

[1] Owing to rounding, individual items may not add to totals shown.

[2] "W" Withheld to avoid disclosing individual company data.

Source: Exhibit C, Table 18.

About 14 percent of the total produced in 1964 was consumed as riprap, and 24 percent was used in manufacturing cement and other special uses.

Imports of crushed stone are significant in the Puget Sound Area; they consist chiefly of limstone and siliceous materials from Canada. Quantities of siliceous materials shipped to the Area from foreign sources are not available.

Reserves of stone are large, but stone deposits of the character or quality required to meet specifications for a particular use are limited in some areas. Crushed stone is a high-bulk, low-unit value commodity, and its economic utility is restricted by its ability to compete on a delivered price basis with alternate materials or sources. Availability and cost of transportation often determine whether a particular deposit is or is not a commercial reserve.

PHOTO 15. Sand and gravel plant on Lake Union. All sand and gravel plants in the State of Washington producing over 500,000 tons annually are located in the Puget Sound Area. Stationary plants produce about 82 percent of the sand and gravel production for the Area. The remaining 18 percent is provided by a number of portable and semi-portable operations. Seattle Times Photo.

Local shortages exist in rapidly urbanizing areas owing to zoning restrictions imposed as built-up areas encroach upon existing quarries; sometimes, buildings occupy ground that otherwise might have been worked for stone in the future. Metallurgical- or chemical-grade stone is a special case with definitely restricted distribution of deposits. Discovery of new sources is becoming increasingly difficult and expensive.

Based upon anticipated or planned public and private construction and continuation of various highway building programs, the quantity of crushed stone produced annually may be expected to increase. Further expansion of the roadbuilding program appears imminent, which would produce an accompanying demand for more road aggregate. Changes in roadbuilding technology caused by heavier and faster traffic also will increase demand for roadstone; currently, more stone is used for wide and heavy shoulders than for the pavement itself.

Present trends in methods for producing crushed stone tend to increase efficiency and reduce costs; increased concern is shown by producers about methods for dust control, water pollution, and noise in quarry operations.

No new uses for crushed and broken stone are in prospect. New quarries to produce aggregate for local buildings are frequently opened and later abandoned as programs are completed. Larger, well-established quarries will expand and modernize equipment as demand increases. Shipping radii of quarries possible will increase through use of innovations such as unit trains and articulated railroad cars. In 1964, the production of stone in the Puget sound Area was about 3.5 million tons. This is expected to rise to 5 million tons in 1980 and 10 million tons in 2020. The following Table 1-48 shows the projected increase by Division.

TABLE 1-48. Puget Sound Area. Stone production, 1980-2020, (million tons)

Division	1980	2000	2020
North	1.4	1.6	1.7
Central	3.3	6.0	7.8
West	0.3	0.4	0.5
Total Puget Sound Area	5.0	8.0	10.0

Source: Exhibit C, Table 38.

Miscellaneous Minerals—Important, but small quantities of olivine, siliceous materials, strontium, and talc are produced annually in the Area. Employment at all mines and plants producing the materials is less than 100 men. Competition makes the future mine production of these materials uncertain.

In the case of olivine, the resource has not been developed to its maximum potential. Many foundry applications for olivine remain to be discovered, and the refractory potential of olivine deserve more research and development.

One of the few commercial strontium deposits in the United States, and the only one in the Northwest, is on Fidalgo Island, Skagit County, near LaConner. In past years, ore was mined intermittently by both underground and open-pit methods.

Metals

Copper—Of 121,927 tons of copper produced in Washington from earliest records through 1964, 7,072 tons came from the Puget Sound Area. The largest production for any property in the Area was from the Sunset Mine in Snohomish County in the 1920's. All copper production from the Area was less than 1 percent of domestic production in 1964.

Gold—Gold contributed the largest total value for metal production in the Puget Sound Area, and output totaled 106,993 ounces valued at $2,688,884. Output has been from operations in Clallam, King, Pierce, Skagit, Snohomish and Whatcom Counties. Whatcom County mines have been the source of most gold (85 percent) produced in the Area.

Manganese—Output of manganese ore from the area approximates 52,000 tons of ore containing 35 percent or more manganese, valued at $1.8 million. Principal production was from operations of the Cresecent Mine in Clallam County. Extensive tests and exploration work have been made on the manganese resources in Clallam, Jefferson, and Mason Counties. However, sufficient exploration has not been performed to accurately estimate the potential reserve of manganese available in the Puget Sound Area.

Other Metals—Small amounts of lead and zinc have been produced, largely as a byproduct at copper operations. Chromite has been mined in Skagit County, mercury in King County, and iron ore and molybdenum have been produced in Snohomish County. The total value of all these commodities was less than $100,000.

Fuels

Coal—About 33 percent of the coal reserve estimate for the State is in the Puget Sound Area. Most of the bituminous coal reserves of the State, or about 1.6 billion tons, are within the Area situated in King (391 million tons), Pierce (362 million tons), Skagit (507 million tons), and Whatcom (320 million tons) Counties.

Sub-bituminous coal reserves of Washington, comprising 67 percent of the total coal reserve estimate, occur south of the Area boundary in Lewis and Thurston Counties.

Output of coal in Washington from five coal mines in three counties was 68,058 tons in 1964. King County led in coal production, followed by Thurston and Lewis Counties. Production of less than 1,000 tons, which is not compiled in annual Bureau of Mines tabulations for coal, was reported by producers in King and Pierce Counties.

Per capita consumption of coal in Washington in 1964 amounted to less than one-fourth (0.23) of a ton. This was considerably lower than the national average of 2.5 tons. Coal consumption in Washington totaled 715,000 tons in 1964, which was 78 percent below the total for 1944.

The decline is attributed to competitive fuels displacing coal in many sectors of the fuel economy. One of the important displacements has been the former lucrative coal market for railroad fuel, which presently is virtually nonexistent owing to the shift from coal to oil-burning equipment. Other inroads on coal markets have been made by other fuels competing for industrial and space-heating requirements where convenience of use is a major factor in consumption. Adverse geological conditions, limited mechanization of mining operations, low productivity of workers, and extraneous matter that is mined with coal, contributed to high costs of coal production in the Puget Sound Area.

With employment of about 50 men in 1964, coal output in the Area was about 5.5 tons per employee. The projections imply output of about 30 tons per man by 1985. Minimum growth predicted in a study assumes productivity of about 7 tons per man for all future years; therefore, the minimum predictions for coal output are near current production in the Pacific Northwest. In the absence of dependable information to the contrary, it is assumed that demand for coal and coal output in the Area will remain constant to the year 2020.[1]

Petroleum and Natural Gas—No petroleum or natural gas has been produced in the Puget Sound Area. However, in the period 1900 to 1964 over 250 exploratory wells were drilled in the Area and immediate surrounding area in search of oil and gas. Most of the activity has been in Whatcom County.

Primary Metal Production

Aluminum—The first aluminum plant in the Puget Sound Area was constructed at Tacoma during World War II. The plant, with present primary aluminum reduction capacity of 41,000 tons annually, was operated until 1958. The plant was reactivated in 1964 due to a continuing increase in demand for aluminum. Also in 1964 plans were announced to construct a 76,000 per year capacity aluminum reduction plant at Bellingham in Whatcom County. The capacity of this plant is expected to increase to 228,000 tons in 1968. With this addition the Puget Sound Area will have a potential output capability of 269,000 tons of primary aluminum annually.

[1] Perry, H., Max R. Geer, C. R. Gentile, and H. F. Jones, H. Zinder & Associates. Potential for the coal industry in the Pacific Northwest. Report prepared for Bonneville Power Administration, 1965, p. 203.

From 1985 to 2020, Pacific Northwest growth was estimated to be less than that nationwide; nuclear power, becoming less expensive by that time, will allow aluminum reduction plants to be located closer to the large aluminum markets. Aluminum output of the Puget Sound Area was estimated to reach 870,000 tons annually by 1985. Aluminum production and raw material requirements by the industry in the Puget Sound Area are shown in Table 1-49.

TABLE 1-49. Puget Sound Area. Aluminum production and raw material consumption

	1965	1980	2000
Aluminum production (1000 tons)	269[1]	680	870
Raw Materials:			
Alumina (1000 tons)	520	1,300	1,700
Carbon anode electrodes (1000 tons)	150	375	475
Cathode carbon (tons)	5,400	13,600	17,000
Cryolite (tons)	5,400	13,600	17,000
Aluminum fluoride (tons)	5,400	13,600	17,000
Fluorspar (tons)	800	2,000	2,600

[1] Estimated primary aluminum plant capacity planned by 1968.

Source: Exhibit C, Table 27.

Copper—A copper smelter and refinery located at Tacoma is a custom operation capable of treating a charge of 600,000 tons of copper ores, concentrates, and fluxing materials annually. Refining capacity of 114,000 tons annually of refined copper. In addition, a 150-ton-per-day sulfuric acid facility utilizes sulfur-dioxide gas obtained from converters.

Refined copper is marketed mainly in Europe and the Far East; a small amount is shipped to domestic consumers. Sulfuric acid output is used principally in fertilizer manufacture. A large portion of raw materials are received from foreign sources such as the Philippine Republic, Canada and South America.

Projections of copper output used in this study were developed as part of a study of the Pacific Northwest copper industry for the Bonneville Power

Administration.[1] Estimated future copper production and associated raw material consumption are not expected to change significantly at the Tacoma operation in the future. No additional expansion was predicted for the Tacoma smelter before 1980, and because output of copper metals is expected to increase only about 1 percent annually after 1985 in the Pacific Northwest, estimates are held constant to 2020.

Steel–There are three steel plants in the Puget Sound Area, all in Seattle, and annual electric-furnace steel-ingot capacity at the plants is about 400,000 tons, or 73 percent of the Pacific Northwest total. Two of the operations are steel rolling mills producing their own ingot, and one is an ingot-forging plant.

Projections of steel output used in this study were based on a study of the Pacific Northwest steel industry for the Bonneville Power Administration.[2]

Steel production in the Area currently is entirely dependent on iron and steel scrap; there are no integrated iron ore reduction plants. In the future, it is possible that a prereduced iron ore pellet or sponge iron from a source outside the Area will be used to supplement the scrap charge. The projections of iron ore consumption were made using the present ratio of iron ore used per unit of steel produced. It is assumed that the present steel plant location at Seattle will exert influence upon the possible future smelting plant location, and that steel output will continue to be from the Seattle area. The following Table 1-50 shows the projected steel production and raw material consumption for the period 1965-2020.

Pulp and Paper

Pulp and paper industry requirements for mineral commodities are complex, and substitution of different raw materials shifts consumption trends sharply. In general, calcium, sodium, and sulfur compounds are used by the paper industry in preparing cooking liquor at pulping operations. By digesting wood with a cooking liquor, all the constitutents of wood chips except cellulose, which is processed into various paper products, are dissolved and removed. At paper-making operations, chlorine which is made from salt (sodium chloride) is used for bleaching, and clays are used for coating and filler purposes.

[1] Knostman, Richard W., and Gary A. Kingston. Copper, Lead, and Zinc Industries in the Pacific Northwest. A report prepared for Bonneville Power Administration, Portland, Oregon, 1966, pp. 87-94.

[2] Kingston, Gary A. The Steel Industry of the Columbia Basin. A report prepared for Bonneville Power Admintion, Portland, Oregon, 1962, p. 58.

TABLE 1-50. Puget Sound Area. Projected steel production and raw materials consumption, 1965-2020

	1965	1980	2000	2020
Steel production (1000 tons)	402	530	750	850
Raw materials:				
Steel scrap (1000 tons)	425	570	800	900
Coke breeze (tons)	700	900	1,300	1,500
Limestone (tons)	10,000	13,300	18,700	21,200
Lime (tons)	4,000	5,300	7,500	8,500
Dolomite (tons)	3,000	4,000	5,600	6,400
Iron ore (tons)	2,400	3,200	4,500	5,100
Fluorspar (tons)	240	318	450	510

Source: Exhibit C, Table 28.

Sulfate- (Kraft) and sulfite-pulping operations and the chlorine-alkali industry are the important users of mineral raw materials for manufacturing pulp and paper in the Puget Sound Area. The groundwood-pulping process is a mechanical operation and does not use minerals.

Sulfate-Pulping Process–The sulfate process of manufacturing pulp uses lime, chiefly for chemical recovery, and salt cake (sodium sulfate) in the system. An advantage of the sulfate process is that processing chemicals are recovered and returned to the system. The Kraft paper and paperboard industry requires an estimate 70 percent, or about 600,000 tons, of sodium sulfate output in the United States.

Sulfite-Pulping Process–In the sulfite process of pulp manufacture, limestone is the source of calcium, and elemental sulfur is used to generate sulfur dioxide, which in turn is converted to sulfurous acid. Lime can be used in place of limestone; however, in the Pacific Northwest, limestone is used at most sulfite-pulping operations. Substantial progress has been made in recent years in devising systems and installing facilities to recover process chemicals used in making sulfite pulp.

TABLE 1-51. Puget Sound Area. Pulp and paper raw material requirements 1964

Type of Operation	Mineral Raw Material Used	Estimated Unit Requirements (lbs. per ton of pulp produced)	Short tons
Sulfite-sulfate	Clay		25,000
Sulfate	Salt Cake (sodium sulfate)	140	40,000
Sulfite	Sulfur	225	87,000
Chlorine-alkali	Salt	NA	370,000
Sulfate	Lime (makeup)	35	10,000
Sulfate	Lime (recycled)	NA	140,00
Sulfite	Limestone	300	115,000
Sulfite	Magnesium oxide	120	0

NA—Not applicable. Source: Exhibit C. Table 30.

Source: Exhibit C. Table 30.

Raw Materials—Raw material requirements in 1964 for manufacturing pulp and paper in the Puget Sound Area are shown in Table 1-51.

Capacity—The following Table 1-52 shows that operations in the Puget Sound Area account for 59 percent of the sulfite-pulp capacity and 39 percent of the sulfate-pulp production capacity in the State. The same operations comprise 48 percent of the sulfite and 20 percent of the sulfate-pulp plant capacity in the Pacific Northwest. About 30 percent of the total pulping operations in the Pacific Northwest is in the Puget Sound Area.

The estimated increase in future demand should absorb any existing unused capacity. At capacity operations about 575,000 tons of sulfate pulp and 775,000 tons of sulfite pulp would be processed annually in the Puget Sound Area.

The pulp and paper industry is expected to undergo rapid expansion until 1980 when value of annual output will have increased from $349.2 million to $683.1 (in 1963 dollars). Associated raw materials consumed in the pulp and paper making process will also increase. During the next two decades the rate of growth will decline appreciably from 3.5 percent annually to 2.0 percent. The value at this point will reach about $1.0 billion. By 2020, annual output will probably be valued at $1.1 billion (1963 dollars) and the yearly growth rate will be less than 1 percent.

TABLE 1-52. Puget Sound Area. Comparison of pulp process and capacity, 1964

	Pulp Process & Capacity (tons per day)		Total Sulfate sulfite Pulping Operations
	Sulfite	Sulfate	
Puget Sound Area			
Total	2,223	1,660	3,883
State Total	4,165	4,435	8,600
Puget Sound Area as Percent of State Total	59%	39%	45%
Pacific Northwest Total	4,635	8,185	12,820
Puget Sound Area as Percent of Pacific Northwest Total	48%	20%	30%

Source: Exhibit C, Table 29.

PHOTO 16. As in other industries, machines are replacing manpower. This unit, which is replacing the lumberjack, takes felled pulp wood trees to 18 inches in diameter. In less than a minute, the machine removes limbs and bark, cuts the logs to length, and stacks them in neat piles. Plywood production in 1963 in the Puget Sound Area represented 12 percent of the national soft wood-plywood production. Wood pulp production was 5 percent of the national total. The production of lumber in the Area was 4 percent of the total United States production. Total wood consumption in the Puget Sound Area is expected to increase from 647 million cubic feet in 1965 to 931 million cubic feet by 2020 due to increased mechanization for both the harvesting and processing of timber. Employment is expected to decline during the same period. Seattle Times Photo.

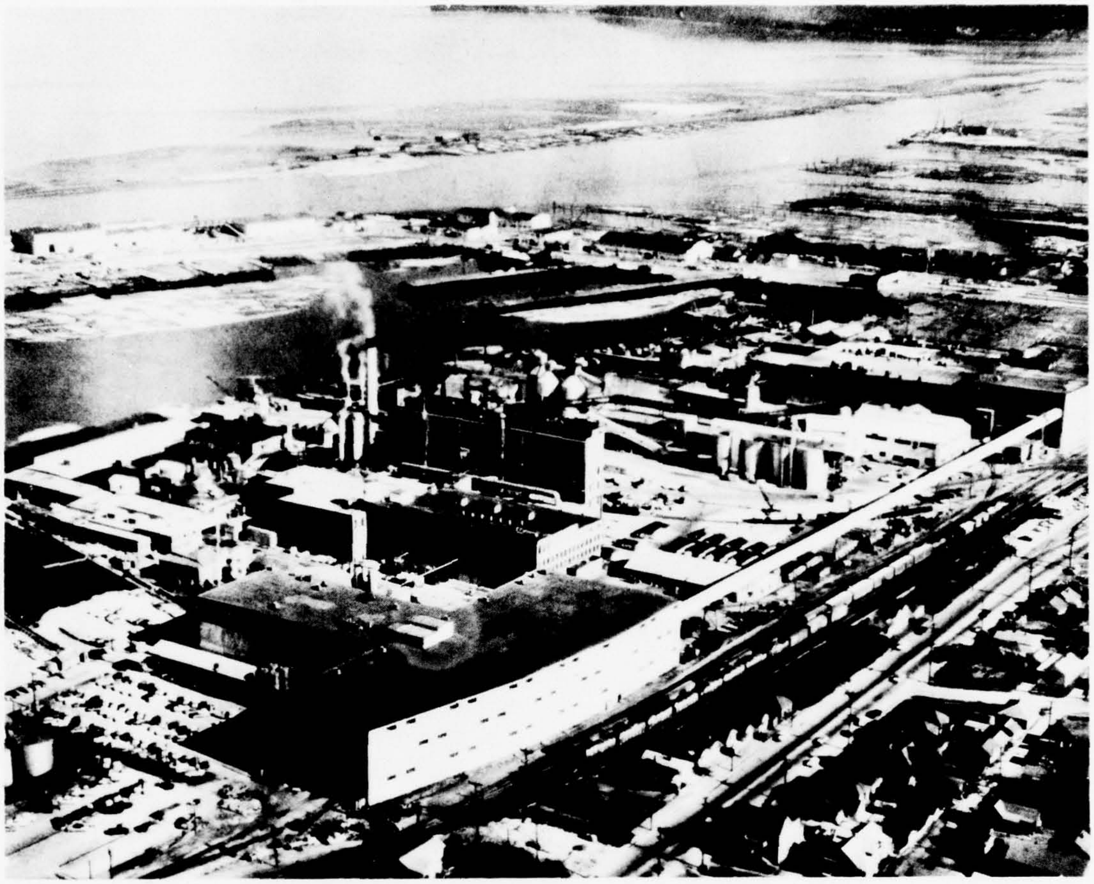

PHOTO 17. Portion of the waterfront of Everett Harbor with the facilities of the Scott Paper Company in the foreground. Operations for the production of pulp in the Puget Sound Area consists of about 59 percent of the sulfite-pulp capacity of the State of Washington. Sulfate-pulp production capacity represents about 57 percent of the total capacity for the State. About 30 percent of the total pulping operations in the Pacific Northwest are located in the Puget Sound Area. Seattle Times Photo.

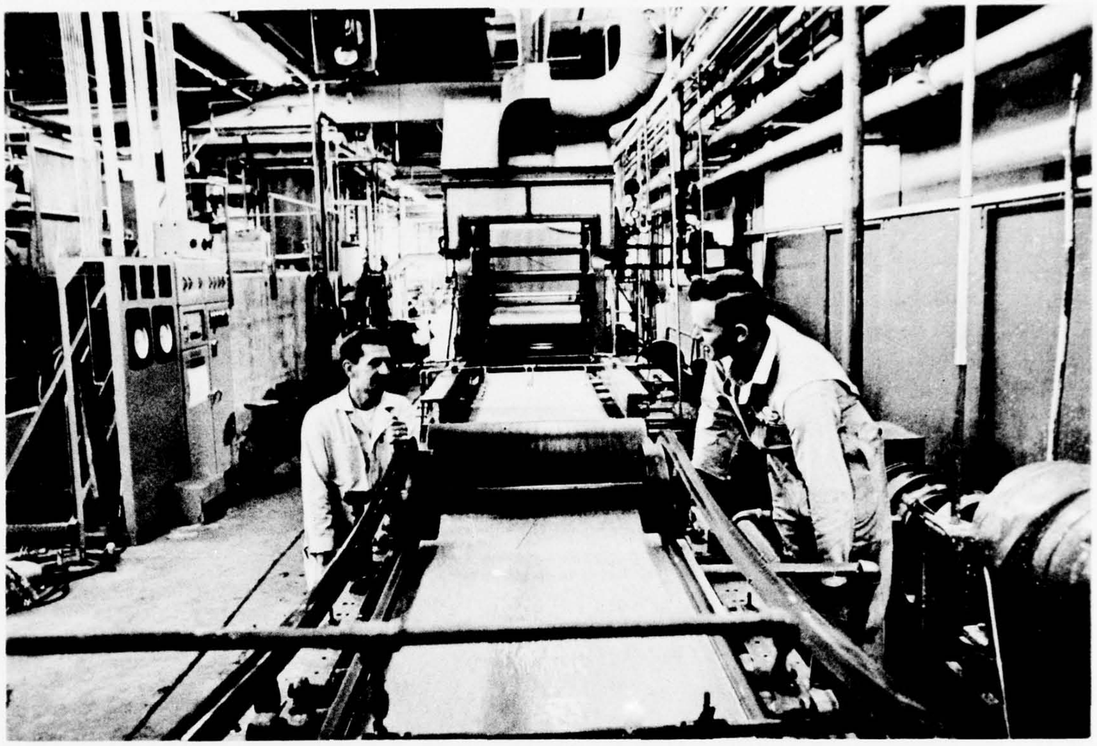

PHOTO 18. A laboratory-sized paper manufacturing machine permits a paper making operation to be intensively studied. This small machine permits commercial runs of paper to be made under varying conditions without disrupting production from a larger paper machine. The pulp and paper industry in the Puget Sound Area is expected to undergo rapid expansion from an annual output base of $349 million to $683 million by 1980. After 1980 the rate of growth is expected to decline, but the annual output by 2020 is expected to reach about $1.1 billion. Seattle Times Photo.

Employment

An estimated 92 percent of the employment in mining in the area is at nonmetal operations, particularly sand and gravel and stone operations, which accounted for about 70 percent of the total employment in mining in 1964. Coal and peat operations and petroleum exploration accounted for about 7 percent of the total employment in mining. Less than 2 percent of the total mining employment was from *metal mining* operations. About 70 percent of the total mining employment is in the Central Division, 25 percent in the North Division and 5 percent in the West Division.

Projections for mining employment in the Puget Sound Area are dependent largely upon the outlook for sand and gravel and stone. Productivity is an important factor in estimating employment trends for these commodities.

Employment by the cement industry could be reduced sharply, possibly by as much as one-half of 1964 employment by 1980. Output in 1964 was from established plants in the Area, and output per

man is estimated to be about 12,500 barrels. Firm commitments have been made by cement operators to construct highly efficient cement manufacturing capacity of 8.5 million barrels before 1970. If plans for additional cement facilities in the Area are realized, output per man from the new plants can be expected to reach about 28,000 barrels. It is assumed that some of the established plants in the Area will remain operational and will take up the employment slack between committed operations. Employment projections for cement and lime operations, therefore, are held constant to 2000 when additional cement and lime plant expansion possibly will necessitate additional employment in manufacturing these materials.

Employment at miscellaneous nonmetals, and coal, peat, petroleum exploration, and metal mining operations is not expected to be over 300 men by 2020. Present employment at operations supplying these minerals is less than 300 men.

Projected employment in the mining industry by Divisions is in the following Table 1-53.

TABLE 1-53. Puget Sound Area. Mining employment 1980-2020

Division	1980	2000	2020
North	580	625	675
Central	1,430	1,750	2,015
West	140	175	210
Total Puget Sound Area	2,150	2,250	2,900

Source: Exhibit C, Table 42.

Employment in the manufacture of stone, clay and glass as well as primary metals is projected in Exhibit C. In 1963 total area employment in the manufacture of stone, clay and glass products was 3,800 persons of which 3,300 were employed in the Central Division. By 2020 the area employment is expected to increase to 8,000 persons with the predominant number (7,100) employed in the Central Division.

In the production of primary metals, the 4,100 employed in 1963 was concentrated in the Central Division. By 1980 almost half of the 7,300 persons employed in this industry will work in the North Division and the balance in the Central Division. This trend is expected to continue to 2020 when the Area employment in primary metals is projected to be 9,900 with 4,200 in the North Division and 5,100 in the Central Division, and remainder in the West Division.

FOOD PROCESSING

Food processing industries consist of canning, freezing and preserving of fruits and vegetables, processing of meat, dairy, and bakery products, as well as grain mills, sugar, confectionary, beverage, and miscellaneous food products industries.

The food processing industry is an important part of the economy of the Puget Sound Economic Area. In 1963 this industry employed about 10 percent of all workers in manufacturing and ranked third among the manufacturing industries. The categories of other durable manufacturers and lumber and wood products employed more workers.

In addition to direct employment in food processing, many jobs in related industries, such as those in supplies, equipment, services, and transportation, are provided. Although this additional employment is related to the existence of the food processing industry, it is discussed in other parts of this appendix.

Although food processing output has expanded rapidly in recent years, employment has declined since 1958. Increases of 2 to 4 percent output per employee annually are common in this industry. The trend to fewer and larger plants has contributed to increasing labor productivity and other efficiencies.

Major inputs to the food processing industry are from farms and fisheries located in the twelve counties of the Puget Sound Economic Area. The most important market area for most of the products of the food processing industries are the Everett-Seattle-Tacoma metropolitan area. However, export markets to California, Alaska, and other parts of the United States absorb a large quantity of canned, preserved, and frozen food products. An important segment of the food processing industry are three breweries located in Seattle, Tacoma and Tumwater. The only other brewing firm in the State is located at Vancouver, Washington. The Washington Brewers Institute estimated that in 1968 these four firms directly supported about 10,300 full time jobs with combined payrolls of about $34 million. The Washington State tax structure provides the lowest taxes on the brewing industry of the West Coast states.

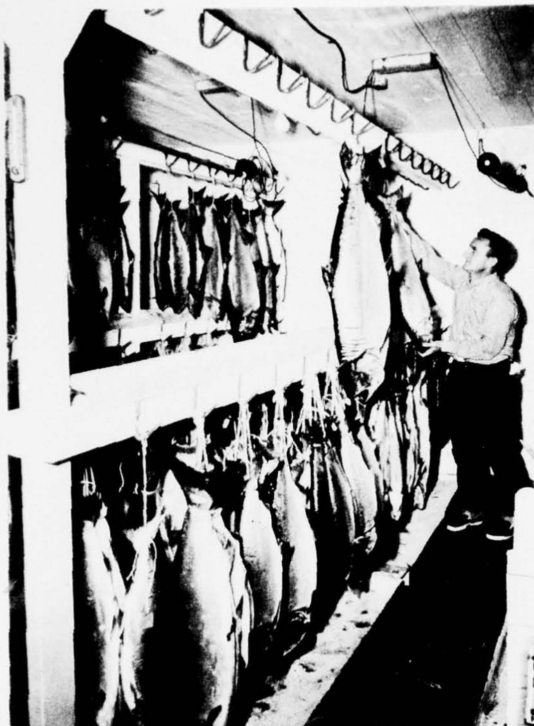

PHOTO 19. The processing of salmon is the principal product of this cannery. The season runs from late May until about mid-October, and the canning process includes both commercial fish and fish caught by sportmen who wish to preserve their catch. The output of all food processing industries, including agricultural and fish products, in the Puget Sound Area was almost $700 million in 1963. By 2020 the output is predicted to exceed $4 billion. Seattle Times Photo.

Washington is the third largest beer exporter in the nation and it is the most important export of any State on the West Coast. The bulk of Washington's export market is to the Western United States, Alaska and Hawaii.

Employment in the food processing industries is highly seasonal. It has been estimated that seasonal employment is about equal to 2,000 employees working full-time for one year and is important source of income for part-time employees. The availability of this seasonal labor is crucial to the food processing industry.

Meat packing, beverages, fruit and vegetables, canning and freezing, and the baking firms employed the greatest number of year-around employees. Firms canning and freezing fruits and vegetables utilized a high percentage of the seasonal labor.

Farms will continue to be a dominant feature of the landscape of the Puget Sound Economic Area of the future. The average farm will be larger and its operator will be using more efficient equipment to grow higher yielding crops and faster gaining livestock. Food processing firms will have to increase output capability to take care of larger quantities of farm produce. More efficient equipment also will be used in the processing of food.

Canning, preserving and freezing output is projected to increase. This sector of the food processing industry has significant export markets that are projected to continue. Production in all other sectors is projected to increase also, but at a rate determined primarily by basin population growth and changes in per capita consumption.

The following Table 1-54 shows the projected employment, output, and value added in the food processing or food and kindred products industries:

TABLE 1-54. Puget Sound Economic Area. Food and kindred products, employment, output and value added, 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	15.9	19.5	22.9	25.6
Output (Millions)	$698.4	$1,240.9	$2,333.4	$4,088.7
Value Added (Millions)	$223.3	$ 405.3	$ 900.3	$1,906.6

Source: Exhibit D.

CHEMICAL PRODUCTS

Nationally, the product output of the chemical industry is the most heterogeneous of all manufacturing industries. Chemical products number in the tens of thousands, with more than 2,500 in the petrochemical group alone. The composition of the aggregate output is undergoing rapid change. Half of today's output represents products which were in their infancy in 1940 or have since been developed. Because of this complexity, only broad generalizations can be made about the level of development for many components of the chemical industry of the Puget Sound Economic Area.

The dominance of the forest products and agricultural industries in the Area has been instrumental in shaping the development of the Area chemical industry. Chemicals required by these industries are in great demand locally. Industrial inorganic chemicals, viz., chlorine and sulphur products, are produced for the regional pulp and paper industry. Synthetic resins and adhesives are manufactured for the plywood and composition-board plants. Fertilizers, soil conditioners, pesticides, herbicides and fungicides are produced for both the regional agricultural uses and residential gardens. Chemicals produced in the Area for industrial markets are also manufactured for both special and general industrial uses; these include oxygen, acetylene, nitric acid, calcium carbide, and others. The diversification of the manufacturing base has encouraged a corresponding diversification of chemical production.

Chemicals more related to the consumer market than to intermediate industrial markets are also produced in the Economic Study Area, such as drugs, soaps and cleaners, paints, and some miscellaneous chemicals. Most of these commodities are produced for internal markets. Increased production, therefore, has been in response to expanding consumer markets associated with population growth. In spite of the wide assortment of chemical products manufactured in the Puget Sound Economic Area, the size of the industry is relatively small. Employment in 1963 was 2,300 and estimated output was approximately $70.4 million, and value added was about $33.9 million.[1]

Conditions which have retarded development of the industry in the main are associated with markets, national production patterns, and for some chemicals, the lack of local sources of raw materials. The market

[1] Exhibit D.

sectors as indicated by the interindustry demand for chemical products are shown in Table 1-55. Several factors stand out. The dominant commodity-producing industries of the Puget Sound Economic Area agriculture and forest products are not large chemical users on a national basis. Nationally these two industries consume approximately 6 percent of the total chemical output.

Much of the output is put back into the chemical industry, the chemical industry being its own best customer. The absence of an established chemcial complex in the Area has therefore retarded expansion. The national center of chemical production has remained in the northeastern United States because of the agglomeration of economies relevant to input access and research. The categories that constitute the least share of the total output of the chemical industry nationally are those which are primarily end-product chemicals drugs, soaps and cleaning detergents, and paints whose market size is related to population. In the past, the Economic Study Area market has been insufficient to justify an economic sale of production for many of these items.

The absence of local sources of raw materials has likewise discouraged production of some chemicals. Of chemicals serving the intermediate market, the least developed in the Area are organic chemicals; the largest nationally of the organic chemical group, petrochemicals, is virtually nonexistent. This group includes synthetic rubber, plastic raw materials and materials for synthetic fabrics. The petrochemical industry is locationally oriented toward the resource input oil of gas production or toward the intermediate market center of tire, textile, or agglomerated fabrication. The absence of both conditions has discouraged basic petrochemical production.

The two industries which consume much of the chemical output in the Puget Sound Economic Area are pulp and paper products and agriculture. Approximately 40 kinds of chemicals are required in the

TABLE 1-55. National demand for chemical and allied products, by major source [1]

Demand by Source (expressed as percent of total demand of selected chemical categories)	Chemical Categories by SIC[2] 281,286 287,289 Percent	282 Percent	283, 284 Percent	285 Percent
Intermediate Market	72.5	83.6	26.5	33.9
Agriculture	9.7	.0	.4	.1
Mining	1.3	.0	.0	.3
Manufacturing	60.0	83.6	13.5	28.1
Lumber & wood products	.5	1.3	.1	2.0
Paper & allied products	2.9	2.4	.4	.1
Chemical & allied products[3]	39.0	42.7	7.5	1.3
Other Manufacturing	17.6	37.2	5.5	24.7
Other industries	1.5	.0	12.6	5.4
End-product Market	18.9	7.2	66.3	59.7
Construction	3.6	.0	.0	57.4
Personal Comsuption	1.8	.2	55.9	.9
Other	13.5	7.0	10.4	1.4
Transfer to Other Industry	8.2	8.4	6.6	6.0
Total	99.6	99.2	99.4	99.6
Total Industry Share	45%	17%	32%	6%

[1] Computed from 1958 input-output table for United States, U. S. Dept. of Commerce, Office of Business Economics, "Survey of Current Business," November 1964.

[2] The standard industrial classification is: 281 industrial inorganics and organics, 282 plastics and synthetics, 283 drugs, 284 soaps, 285 paints, 286 gun and wood chemicals, 287 agricultural chemicals, and 289 miscellaneous.

[3] Includes synthetic textiles.

production of pulp and paper products, the two most important being chlorine and sulfur products. The chemicals in the greatest demand in agriculture are phosphate products, potash and ammonia. Projected production of ammonia is related to estimated use of fertilizer in agriculture. Future production of phosphate products and potash in the Area is unlikely.

Development of petrochemicals, gum and wood chemicals industries is not likely to take place. If offshore petroleum is discovered, the probability of petrochemical production in the Puget Sound Economic Area would be greatly enhanced and would likely be located near water transportation facilities. The present state of research in chemical production from wood fiber as well as technological problems prospects of wood chemicals. Should either of these industries develop, the projections may be understated.

As economic production and population in the Area and region expand, it becomes economically feasible to manufacture more products locally. Increased advantages of market access stimulate expansion of many commodities of the chemical industry. These advantages are reflected in the favorable growth of this industry. The rate of development of the chemical industry is responsive to the growth in existing industrial and consumer markets and at the same time to markets supporting new products.

Production of chemical and allied products in the Puget Sound Economic Area is projected to increase in terms of output from $70.4 million in 1963 to $553.7 million in 2020. However, due to increased mechanization and improved technology, employment by 2020 is expected to drop to less than half of the 1963 employment. The following Table 1-56 compares employment output, and value added in the chemical industry for the period 1963-2020.

TABLE 1-56. Puget Sound Economic Area. Chemical and allied products, employment, output, and value added, 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	2.3	1.8	1.3	.9
Output (Millions)	$70.4	$138.6	$287.0	$553.7
Value (Millions)	$33.9	$ 68.4	$170.4	$420.2

Source: Exhibit D

PETROLEUM REFINING

The function of the petroleum refinery is to convert crude oil, which has few uses in its raw state into usable products. Refinery products number in the thousands if account is taken of the numerous distinctions between different grades and qualities of major products, and of refinements, additives and processing techniques introduced by different refining companies to establish special individualized brandname characteristics. For example, there are five major grades of aviation gasoline; three grades of jet propulsion fuels for aircraft; three standard grades of diesel fuels; and five standard grades of fuel oils. Product differentiations among the waxes, lubricants, petrochemical feedstocks and other petroleum products are so numerous as almost to defy listing.

Petroleum, in both crude and refined form, is moved domestically by virtually all modes of transportation known to man: by pipeline, tank truck, inland waterways barge, and railroad tank car.

By a rather considerable margin, pipeline transportation is the most important means of moving petroleum products domestically. In 1960, about 74 percent of all crude oil deliveries to U. S. refineries were made by pipeline—a movement by pipeline of more than 2 billion barrels annually, almost 6 million barrels per day. In addition, pipelines hauled about 43 percent of total deliveries of products (gasoline, kerosene and distillate, excluding natural gas liquids).[1]

Petroleum pipelines are of two general types, crude oil lines and product lines. Crude lines move the crude from producing areas to refining centers; products lines extend from refineries to bulk terminals at principal consuming areas. Distribution from bulk terminals typically is made by tank trucks to cities within a 100-mile radius, and either by railroad tank car or tank truck for longer hauls.

The Pacific Northwest is only sparsely provided with petroleum pipeline facilities. This results in large part from the paucity of refining capacity in the region, although other factors play a part (for example, the accessibility of Seattle and Portland to ocean-going tankers).

[1] Pacific Northwest Economic Base Study for Power Markets, Petroleum, Volume II, Part 11C, Bonneville Power Administration, U.S. Department of Interior, 1966.

The only crude pipeline in the Puget Sound Economic Area is a short spur extending south from the Canadian border to the refinery complex in the Anacortes area of the North Division. This pipeline connects to the Mobil Refinery at Ferndale, and the Shell and Texaco Refineries at Anacortes. This spur is the southern terminus of a major Canadian transporter, Trans Mountain Oil Pipeline Company. The Trans Mountain line extends north and east to Edmonton, Alberta. Enroute, at Kamloops, British Columbia, a line of the Western Pacific Products and Crude Oil Pipelines, limited, empties into Trans Mountain. The Western Pacific line originates in the Fort St. John area of northern British Columbia. The main section of the Western Pacific line is 12-inch and the main section of Trans Mountain is 24-inch. The National Petroleum Council shows the capacity of Trans Mountain into the United States as 200,000 barrels daily.

Petroleum transportation by tank truck has been increasing. The relatively recent development of modern cleaning facilities has been an important factor in stimulating this increase. Adequate cleaning facilities permit a truck to haul petroleum products, chemicals, or petrochemicals interchangeably, so that one product can be hauled on the initial run, and another product hauled in the opposite direction on the return trip. This added flexibility enhances the economics of movement by truck. Another important factor, working hand in hand with the first, has been the improvement in specialized truck designs for handling specific products, particularly chemicals and petrochemicals. Illustrative is the growth in the high pressure truck fleet.

Tank trucks built for dry bulk hauling are part of the overall petroleum tank truck facility picture, at least potentially, since a large percentage of the dry bulk tanks could readily be converted to liquid bulk service. Recent refinements in the design of dry bulk tank trucks have been striking and have enhanced their adaptability for conversion. Therefore, some of the statistics which follow include dry bulk tank trucks. In the Puget Sound Economic Area petroleum is also transported by inland waterways and railway tank cars.

The future of the petroleum industry in the Pacific Northwest region, as compared to the industry elsewhere in the United States, is at once similar and unique. As of the spring of 1965, after several years of intensive geological and geophysical surveys conducted by a number of major petroleum producers, the door is now open for initial exploratory drilling for oil and natural gas in the offshore waters of Washington. This will be strictly wildcatting. Results are unpredictable. Nevertheless, the clear possibility exists that coastal areas of the northwest may become the nation's newest important source of petroleum reserves. If oil or gas is found, the petroleum industry will have achieved a new and stimulating stage for domestic exploration and development, and the Northwest will stand on the threshold of greatly expanded economic opportunities.

The future development of the Puget Sound Economic Area's crude and products pipeline systems will depend a great deal upon whether success, or failure meets current efforts to find petroleum offshore. If substantial reserves are discovered additional refinery complexes may be expected along the coast. These refineries will be fed by new crude pipelines, and their output will be distributed in large part by new products lines. However, even if the offshore search is unsuccessful, additional products lines will be needed as the population expands in areas beyond the reach of ocean tankers and inland barges, and to supplement short-haul rail and truck shipments in areas where the primary long-haul transportation is by water.

It is because of this possibility that the future of the petroleum industry in the Northwest is unique, for the offshore areas of the region's coastal states are potentially the most significant of the still-to-be-explored frontiers in the country. The Puget Sound Economic Area could change almost overnight from an oil and gas importer, completely dependent upon outside sources for its petroleum supply, to an oil and gas producer and exporter. Oil resources currently being developed on Alaska's North Slope are reputed to be rated at between ten to fifty billion barrels and could double present U.S. oil reserves. In February 1969, announcement was made of the planned construction of an 800 mile, 48-inch pipeline to move crude oil south to a site on the Gulf of Alaska in the vicinity of Anchorage. The pipeline system is estimated to cost $900 million and completion is scheduled

for 1972. Consideration is being given to transportation of oil by tanker or barge to the Puget Sound Area and thence to the Midwest by pipeline.[1]

On the marketing side, the industry's future in the Study Area generally parallels that of other regions. But there are two important exceptions to the similarity, both of which relate to fuel oil markets. First, is the strong orientation of the Northwest to electricity as a source of energy, coupled with plentiful supplies of cheap electric power. However, the more economical hydro sites have been developed and the Northwest must look toward a combination of hydro and thermal generation as a source of energy. The combination of higher cost energy from coal or nuclear-fixed thermal plants and low cost of hydro energy assures the Northwest of a continuing supply of low-cost power as compared to other regions of the Nation. The electric energy-consciousness of the Northwest goes back many years, even prior to the inception in the late 1930's and early 1940's of the now vast Columbia River Power System of the Federal Government. Second, is the belated introduction of natural gas into the region in 1956-1957. The Northwest was the last major area of the Nation to receive natural gas. The availability of gas is still limited to the larger population centers, so the impact of this relatively new fuel has not year been felt in full. These two highly competive factors dampen somewhat the future of the Northwest market for fuel oils. In contrast, elsewhere in the United States, electric power competition is not so severe; and natural gas, having been available longer and with wider area coverage, has made greater inroads to date.

In the Study Area, the Shell-Texaco-Mobil refineries which provide the bulk of the refining capacity are all located on deep water with tanker receiving facilities. These refineries are supplied by the Trans Mountain pipeline from Canada which transmits British Columbia and Alberta crude oil into the United States. This line has a capactiy with present pumping of about 200,000 b/d but with additional pumping could triple that capacity to reach a maximum of about 600,000 b/d.[2] Also, of course, virtually unlimited supply can be made available to these refineries by tanker from Alaskan and foreign ports (including the prolific Middle East producing area). Plans are currently underway for Richfield and Standard Oil to establish refineries in the vicinity of Bellingham in the North Division. Transportation of refined products from the three area refineries presently is largely by tanker or barge, with a small part by tank truck. The investment represented by the Shell-Texaco-Mobel refineries is not a matter of public record but probably is in the neighborhood of $200 million (estimated on a rule-of-thumb basis of about $1,400 per barrel of daily capacity).

The location of these three major refineries in the North Division undoubtedly is strongly influenced by the circumstances that this Area meets a number of the primary requirements for refinery sites. First, there are deep water facilities to receive, load and unload tankers. This is important to provide flexibility for receiving foreign and Alaskan imports of crude as well as for the dispatching of finished products. Second, further bolstering a favorable supply location, there is access to a dependable supply of crude which is not subject to ocean-going hazards (in this case, via the Trans Mountain crude pipeline). Third, there is a dependable power supply. Electric energy requirements for refining are approximated at 3-killowatt-hours per barrel of crude input, with a high load factor, probably about 90 percent or better.

1 Business, "Alaska Strikes It Rich" February 1, 1969, p. 49. Seattle Post Intelligencer "$900 Million Oil Pipelines for Alaska," February 12, 1969, p. 4.

2 It must be noted that the importation of Canadian crude oil for the Puget Sound refineries has been subject to attack in the U.S. Whether criticism of these imports will result in any future curtailment of this source of supply cannot be known at this time, of course. For details, see: The Oil and Gas Journal, "Canadian imports into Puget Sound hit," April 29, 1963, p. 68; and, The Oil and Gas Journal, "Interior silent on Canadian imports," May 13, 1963, p. 71.

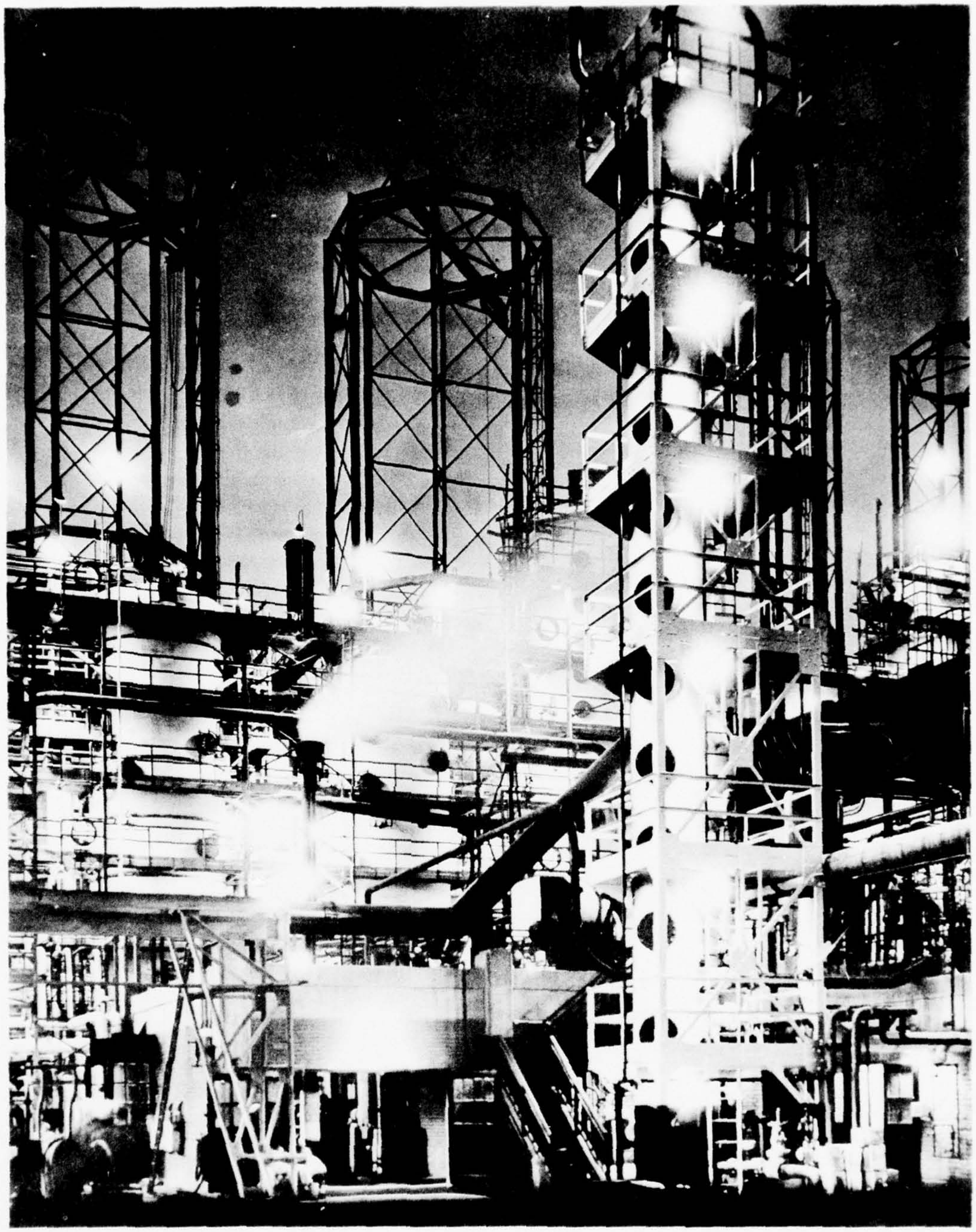

PHOTO 20. Petroleum refinery complex. Most of the crude petroleum processed in the Puget Sound Area is imported from Canada through a system of pipelines. After processing, petroleum products are transported by waterborne tankers and barges, and tank trucks. Oil reserves currently being developed on Alaska's North Slope are reputed to be rated at between 10 to 50 billion barrels and could double present United States oil reserves. Plans are being formulated to transport this crude oil by pipeline and tanker or barge to the Puget Sound Area, then to the Middle West by pipeline. Seattle Times Photo.

The following Table 1-57 represents the projections for employment output and value added for the petroleum refining industry in the Puget Sound Economic Area.

TABLE 1-57. Puget Sound Economic Area. Petroleum refining, employment, output and value added, 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	1.2	1.4	1.4	1.4
Output (Millions)	$225.9	$511.8	$1,080.2	$2,124.7
Value Added (Million)	$ 61.5	$123.0	$ 301.4	$ 729.1

Source: Exhibit D.

OTHER MANUFACTURING INDUSTRIES

The term "other manufacturing industries" includes those industries not previously discussed under the categories of forest products, minerals and metals, food products and chemicals. Other manufacturing industries include the manufacture of non-durable items such as textile, rubber, plastic and leather products and printing and publishing. Durable items include such products as fabricated metals, machinery, transportation equipment and professional instruments.

The dominant share of the output of other manufacturing industries goes directly to the end-product market. Direct personal consumption accounts for the major part of the purchases of clothing, household furniture and household appliances. Location and size of the market for these commodities are directly associated with population and per capita income. Demand by industry and government for capital equipment is a major market determinant of several industries. For example, manufacturers of machinery, electrical machinery, instruments and transportation equipment sell to other foreign and domestic industries, as well as local, State, Federal, and foreign governments.

Population increase and rising per capita income in the Puget Sound Economic Area have enlarged local markets for many personal consumption commodities and household items. Increased production by existing firms and establishment of new firms have caused increased demand for capital equipment and inputs for higher stage fabrication and industrial expansion. Concomitant expansion in government, services and construction has required more building supplies, furniture, and office equipment. Clearly, growth in all sectors of the economy has added to the demand for products of this industry group.

The most predominant durable manufacturing industry in the Puget Sound Economic Area is in the manufacture of transportation equipment such as aircraft and shipbuilding and repair. In this category one company, The Boeing Company, is outstanding in terms of the impact on employment, output and value added in the Economic Study Area. In 1967 with employment at about 95,000 this single company had an average weekly payroll of $19 million or $4 million a work-day in the State of Washington. Essentially, all of the activities of the company are centered in the Central Division.

The Boeing Company, founded in 1916 in Seattle, Washington, has produced more commerical jetliners than any other company, and in the last two decades also has become a leader in the missile, rocket, helicopter and space fields. Boeing now has more than 140,000 employees, including more than 95,000 in the State of Washington. The company is composed of the Aerospace Group in Seattle and Kent, Washington; its Launch Systems Branch in the Southeastern U.S.; the Wichita (Kansas) Division; the Vertol Division in Morton, Pennsylvania; and the Commerical Airplane Division. The latter has five branches: Renton, Seattle, Everett, Auburn and Supersonic Transports, all in the Central Division of the Economic Study Area. Boeing of Canada, LTD., in Arnprior, Ontario, and Boeing International Corporation are subsidiaries. The Boeing Company's headquarters is in Seattle.

Boeing has built more than 28,000 aircraft in its various factories. More than 16,000 had two or more engines, and more than 4,000 have been jets. From the company's drawing boards have come the military B-17 Flying Fortress, the B-29 and B-50 Superfortresses, the C-97 Stratofreighter, the B-47 Stratojet, the B-52 Stratofortress, the KC-135 jet Stratotanker and the C-135 jet transport. Boeing's reputation in commercial aviation stands on Stratoliners and Model 314 Flying Boats of the 1930's, the postwar Stratocruisers and the current line of 707, 720, 727, 737 and 747 jetliners.

Early research and development produced the Boeing 247, delivered in 1933, which was the first all

metal twin-engine transport. Its basic design is still dominant in transport aircraft. Among the innovations were control-surface trim tabs, an automatic pilot, de-icing equipment and supercharged engines of the type formerly used only on military airplanes. It was one of the first twin-engine airplanes capable of climbing to altitude on one engine with a full load. With accommodations for 10 passengers and a crew of two plus a stewardess, the 247 revolutionized air traffic by making possible 20-hour coast-to-coast flights with only seven intermediate stops. Seventy-five were built, and some are still flying.

In 1934 the Army announced competitive tests for a "multi-engined" bomber. Other aircraft companies interpreted "multi-engined" to mean "two-engined." Boeing engineers concentrated on four, and the resources of the company were devoted to the task. The end product was the B-17 of World War II fame. By war's end 12,731 B-17's had been built—6,981 by Boeing and the others by Douglas and Lockheed. They had dropped 640,036 tons of bombs, and they had shot down almost as many enemy aircraft over Europe as all other American airplanes combined, including fighters.

Early in the war, American military planners realized that neither the Flying Fortress, nor any other airplane of its size, would be able to carry the war over the vast distances of the Pacific. They needed an airplane with an even greater range and striking power, yet one which would retain the ruggedness of the B-17. Such a plane was the B-29 Superfortress, the first of which was completed by Boeing in September, 1942. It became the first pressurized heavy bomber produced in quantity and the first with a complete remote-controlled gunfiring system. It too, set the pattern for bombers which followed By the end of the war, 3,970 of the 60-ton bombers had been built—2,766 of them by Boeing.

With the advent of jet aircraft, Boeing's contributions to the Strategic Air Command's currently-manned weapons were the B-47 six-engined Stratojet and the eight-jet B-52 bombers. The various models of the B-52 still form the principal striking force for SAC. Flying teammates of the B-47 and B-52 were the KC-97 Flying Boom Tanker and the KC-135 jet Stratotanker.

In August 1952, Boeing announced it was investing $16 million in the development of a prototype jet transport. From the company's background in swept-wing B-47 and B-52 production came extensive experience with high-performance jet aircraft. But the forerunner of all Boeing planes to follow—the 367-80 and more frequently called "the Dash Eighty"—was a departure from the military bombers.

The Model 707 prototype, the Dash Eighty, was rolled from the Renton factory in May 1954, and made its first flight on July 15, the 38th anniversary of Boeing's founding. In October 1955, the first order was received from Pan American World Airways for a commercial jet, and the airline put the first Boeing jet airliner in service on it trans-Atlantic route on October 26,1958. After the 707 the company produced other jet type transports in the 700 series such as the 727 and 737 to fill the versatile need of customers. By June 1967 Boeing delivered its 1,000th commerical jet.

In July 1966 Boeing announced that it would build the Model 747 jetliner, a 490-passenger subsonic transport which offered to the world's airlines a new concept in air transportation. With a gross weight of 710,000 pounds and a 20-foot-wide cabin, the 747 will carry up to 110 tons in an all-cargo version, more than twice the capacity of 1968's jet freighters.

To build the giant jet, Boeing first had to construct a facility extensive enough to handle the world's largest civilian jetliner. At Everett in the Central Division, the world's largest volume building—160 million cubic feet—was constructed. Work began in August 1966, and the first employees arrived at the site in early 1967. The work force reached 5,000 by the end of 1967. The first successful test flight of the 747 Jumbo Jet occurred in early 1969.

In September 1963, the Boeing Company announced it would be a contender in the United States Supersonic Transport (SST) design competition. A total of $17 million had been spent on SST research by the fall of 1963 and more than $40 million by the end of 1967. The FAA announced on December 31, 1966, that the company had won the SST design competition. General Electric Company was chosen as engineer design winner. The development and production and maintenance of the SST is expected to provide the Boeing Company with continuing future sales of significant magnitude to be an important factor in the economy of the Puget Sound Economic Area. Other research, development and production by the Boeing Company is in the field of military, research missiles and aerospace equipment, helicopters, and hydrofoil boats.[1]

[1] The Boeing Company, Seattle, Washington.

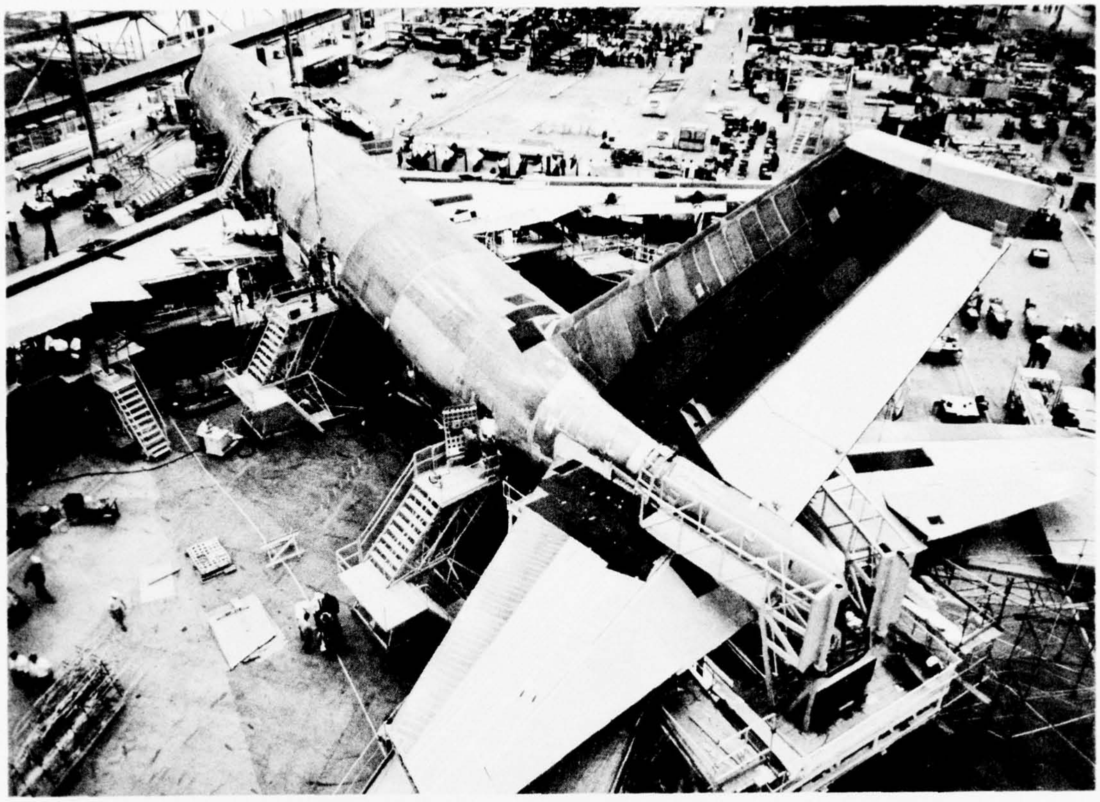

PHOTO 21. Production of Boeing 747 giant jet transport. Manufacturing industries in the Puget Sound Area are expected to provide one of the sources of employment to encourage future population growth. Employment in manufacturing for 1963 was approximately 101,000 and is expected to increase to about 818,000 by 2020. The output of manufacturing production was estimated at $2 billion in 1963 and is projected to increase to $160 billion by 2020. Boeing Company Photo.

Employment by Boeing in the State of Washington during the period 1958-1968 has been:

1958	65,700	1963	61,100
1959	64,200	1964	50,600
1960	55,800	1965	55,700
1961	60,700	1966	80,900
1962	70,300	1967	94,600
		1968	95,000

Source: The Boeing Company, Seattle, Wash.

Practically all of this employment was in the Central Division. Projections of the economic activity in manufacturing reflects the continuing impact of the Boeing Company on the economy of the Puget Sound Economic Area. Sub-contracting for the supply of component parts and equipment constitutes an additional element to production of supersonic aircraft and aero-space equipment and is expected to have a significant impact on the projections in the category of other manufacturing. Projections for the period 1963-2020 in terms of employment, output and value added are as follows:

TABLE 1-58. Puget Sound Economic Area. Other manufacturing[1] Employment, output, and value added, 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	101.2	195	406	818
Output (Millions)	$1,984.6	$15,805	$119,448	159,572
Value Added (Millions)	$1,051.6	$ 2,596	$ 8,176	$ 25,505

[1] Includes durable items as fabricated metals, machinery, transportation equipment, tools, instruments, and non-durable goods as *textiles, rubber, elastic, leather products and* printing and publishing.

Source: Exhibit D.

RESIDENTIARY INDUSTRIES

Residentiary Industries are defined as those which provide services primarily to people living in or adjacent to an area. Industries included in this category are: transportation, communication, utilities, construction, retail and wholesale trade, finance, insurance, real estate, personal services, self-employed and State and local government. The primary impetus which sets the pace for economic growth are the basic industries which provide commodities for a regional or national market and are largely independent of local markets. Residentiary industries are dependent upon the level of development in the basic industries as they largely serve local markets. The number of people requiring services is a major determinant for the number of employees in these service businesses and industries.

The recreation and tourism industry is important in the Puget Sound Economic Study Area. However, employment output and value added are not easily distinguishable from the usual industrial categories. In terms of the Standard Industrial Classification Code, there is no tourism and recreation industry enumerated. Rather, it is a combination of a number of industries, such as a variety of different manufacturing, wholesale, retail, and service trades industries, part or all of whose employment and output is connected with recreation and tourism expenditures. In the CSC input-output study some recreation and tourism expenditures appear as consumption expenditure by local residents and expenditures by non-residents are included in the export column.

Services

Service industry employment is projected to increase nearly 500,000 between 1963 and 2020, or about 27 percent of the increase in total employment over this period. As a result, the service sector's shared or total employment will increase significantly from the 22 percent registered in 1963 to 26 percent in 2020. The more than fourfold rise in employment will be accompanied by a 900 percent increase in value added and a 600 percent increase in output which is demonstrated in Table 1-59.

TABLE 1-59. Puget Sound Economic Area. Services, employment, output and value added 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	144.0	230.1	388.8	627.3
Output	$1,149.4	2,185.9	4,356.0	8,088.8
(Millions)	$ 842.2	1,604.5	3,711.8	8,477.0

Source: Exhibit D.

Wholesale and Retail Trade

Wholesale and retail trade, the largest service industry in terms of value added, is projected to maintain the lead through 2020. As with most service industries wholesale and retail trade require extensive labor inputs and are difficult to automate compared with an industry such as communications, for example. Thus, along with the large projected increases in output and value added between 1963 and 2020, employment is destined to nearly triple as shown in the following Table:

TABLE 1-60. Puget Sound Economic Area. Wholesale and retail trade, employment, output and value added 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	139.9	202.6	292.3	402.5
Output (Millions)	$1,250.3	2,269.4	4,267.3	7,477.7
Value Added (Millions)	$1,011.3	1,835.4	4,006.3	8,634.2

Source: Exhibit D.

PHOTO 22. Seattle-Tacoma International Airport is becoming increasingly important for international flights as well as flights to and from domestic points, Alaska and Hawaii. Activity at the airport has encouraged the construction of transient accommodations and multi-family dwellings in the immediate vicinity. The airport is an important factor for present and future employment in the sectors of services, wholesale and retail trade, as well as transportation, communications, and public utilities. Seattle Times Photo.

Government

Government employment, as a percent of total employment, will decline from 17.5 percent in 1963 to 16.7 percent in 2020, despite the employment increase of nearly 300,000 over the period. Government activity measured by value added based on projections will be 1,200 percent larger in 2020 than in 1963, the greatest percentage increase of any of the non-commodity industries. The projections for employment and value added are shown in Table 1-61.

TABLE 1-61. Puget Sound Economic Area. Government, employment and value added 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	115.7	178.1	275.2	405.8
Value Added (Millions)	$734.0	1,565.1	4,140.8	9,816.5

Source: Exhibit D.

PHOTO 23. Seattle-First Office Building, fifty-story structure which was completed in 1969 and is the highest office building in Seattle. The construction industry is expected to enter a period of significant technological advance between 1963 and 2020. While employment is projected to only double, the value added by the construction industry in the Puget Sound Area is projected to be eleven times greater than 1963. Seattle Times Photo.

Construction

The construction industry, notoriously difficult to modernize and automate in the past, will enter a period of significant technological advance between 1963 and 2020. Employment is projected to double while value added reaches a level 11 times greater than in 1963. As a consequence, value added per worker per year will increase from $6,700 in 1963 to nearly $40,000 in 2020. Table 1-62 shows employment output and value added for construction activity in the Puget Sound Economic Area in 1963-2020.

TABLE 1-62. Puget Sound Economic Area. Construction, employment, output and value added 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	41.2	54.4	70.6	87.1
Output (Millions)	$673.8	1,359.7	2,869.9	5,644.8
Value Added (Millions)	$277.0	558.8	1,395.8	3,442.6

Source: Exhibit D.

Transportation, Communications and Public Utilities

The expanding population of the Puget Sound Economic Area will require increased quantities of these services as evidenced by the 645 percent and 849 percent increases in output and value added, respectively, between 1963 and 2020. Worker productivity will be of such a magnitude, however, that employment is projected to decline 42 percent over the 57-year period. This productivity increase will result from significant technological advances and a movement toward a highly automated, capital intensive industrial structure. Table 1-63 compares employment, output and value added for these industries for the period 1963-2020.

TABLE 1-63. Puget Sound Economic Area. Transportation, Communications, and Public Utilities. Employment, output and value added 1963-2020

	1963	1980	2000	2020
Employment (Thousands)	40.3	36.2	29.8	23.3
Output (Millions)	$615.8	1,192.8	2,422.7	4,585.5
Value Added (Millions)	$461.1	894.6	1,990.8	4,373.6

Source: Exhibit D.

ECONOMIC PROJECTIONS

GENERAL

Exhibit D, prepared by Consulting Services Corporation, projects economic activity in terms of output,[1] value added (gross regional product),[2] employment and population from a 1963 base to 1980, 2000 and 2020, the major forecast effort aimed at the year 1980 with a projection method involving input-output analysis. This relatively new technique in regional analysis not only examined the present, but provided a tool for viewing the future. The 2000 and 2020 projections utilized different forecasting methods.

The 1963 analysis of the Puget Sound Economic Area was highly dependent upon the recently completed interindustry study of the State of Washington. For that year, a 54-sector purchase and sales flow model of the State's economy was developed by a group of researchers from the University of Washington. Both the final product and many of the unpublished working papers were made available for generating the model for the Puget Sound Economic Area.

Under normal circumstances it is necessary to gather a wealth of primary data on purchase and sales characteristics of individual industries. This task can only be accomplished by a comprehensive survey of producers and suppliers. Since the Puget Sound Economic Area is responsible for roughly two-thirds of the total State economic activity, it was possible to use the State framework for determining upper limits to the relative size of flows. While differences might arise related to the factor of import substitution because of differences in the industrial structure of the region as compared to the State, the primary concern in modifying the industrial sectors was that proper account would be taken for differences in output composition.

Each and every industry in the Area was aggregated into 56 sectors—from agriculture through manufacturers, services and the like—tables were developed showing sales output to: (1) every other industry in the area: (2) local consumers, local investors and local governments; and (3) sales to the Federal Government, other areas of the United States and to world markets. The sales to other industries in the Area represented purchases by these industries. These relationships indicated the influence of output changes in one industry on its suppliers and, in turn, on their suppliers.

[1] Output is equivalent to sales except for those industries where "margin" entries are used. "Margin" represents the markup costs involved in producing a service as in the case of wholesale and retail trade, banks, insurance and real estate.

[2] Value added as used here and in Exhibit D is the value of sales less the purchase of goods and services from other firms. It is equivalent to the contribution of an industry to gross regional product. Value added includes wages and salaries, interest payments, rental payments, profits, depreciation and business taxes.

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Changes in the demands of local consumers, investors and governments by and large depend upon their incomes. In the case of local governments it was the size of the total regional income. Demands outside the Area were more basic. For example, the current upswing in economic growth of the Area in large part reflected the ability of aerospace to sell to: buyers in other areas; the Federal Government; and to foreign nations.

Final work on the 1963 interindustry model was undertaken to explain the relationship to extra-regional sources of supply and export markets of Puget Sound Economic Area output. The residentiary or market oriented industries were identified and for these industries the total purchases of inputs were allocated to regional suppliers. The relative concentration of basic industry was determined from unpublished data of the Washington Interindustry Study, information provided by individual firms, data from the Census of Manufactures, as well as wage, salary and employment data. Where appropriate, purchases of inputs were reallocated from the interindustry matrix to the import sector. In addition, the contributions of local trade and transport services were accounted for by allocating margins from the estimated quantities of purchased input to the service sectors, according to data from the Washington input-output study. The final transactions matrix was developed by successive adjustments to a table of technical coefficients.

PROJECTIONS FOR 1980

Projected 1980 input coefficients or percentage relationships were developed directly from the 1963 data. The Washington study provided certain guidelines regarding changes in productivity and import subustitution. National projections of Federal demand, world trade exports and output levels in other areas in 1980 were available or were developed. Knowledge of present ties to these markets and given their projected growth, a projection of Puget Sound Economic Area sales outside the area was generated. These, in turn, were fed through the framework or model in order to examine the impact on local serving industries. The 1980 projections were based on available projections of individual industries. However, for the vast majority of industries, projections had to be developed for the demand for their outputs.

In the projection process, account was taken of: changes in technology, expected local production of goods now imported into the Area; productivity increase; labor force participation rates; the changing pattern of consumer behavior as per capita incomes increase; and the emergence of new industries. Further care was taken not to project output greater than available supply conditions warrant, such as in forest products.

Export Projections

Economic activity in an area may grow or decline depending upon exports to other areas. The term "export" as used in this context refers to sales outside a study area and not to foreign trade alone. For the Puget Sound Economic Area sales to the Federal Government constituted an important component of the export market. In general, some industries had their level of output determined by Federal, national and international demands. Other industries, such as retail, serviced the local market and levels of output were determined by the general economic vitality within the area. The export base framework divided industries into two groups: those that served outside markets and those that served internal markets. It has been found that as an area expands its sales to outside markets, output levels in internal markets also increase. The determination of the export sales of the various industries of the Area in 1980 depended upon demands generated outside of the Study Area. The Study identified three separate areas of demand: (1) Federal Government demands, especially those for defense-space activities; (2) world trade demands; (3) demands originating in the States of California and Oregon; and demands emanating from the rest of the United States, omitting those two states:

(1) Projections of sales to the Federal sector in 1980 were taken from the recent work of Clopper Almon.[1] For the year 1980, Almon has developed a set of estimates of "defense-like" purchases by the Federal Government. These were made under the assumption that the cold war will continue. The basic premise in the projection was that the Puget Sound Economic Area would supply the same share of these defense-like expenditures in 1980 that it held in 1963. One important exception in this projection process concerned the aerospace industry which was

[1] Almon, Clopper—The Structure of American Industry to 1975 (New York Harper and Row, 1966).

independently projected. It should also be noted that the more routine activities of the Federal Government within the Area, such as the Post Office, depend more on local growth than on national forces. They were included with State and local governmental expenditures and projected along with them.

(2) Projections of world trade sales from Puget Sound Economic Area industries were made on the basis of national trends in the various industries. World trade as used in the Study applies to sales by area industries to world trade. This is not the same thing as the volume of shipments through the various ports of the Puget Sound Area, which includes many products not produced in the area. For the United States, world trade projections were made for various commodity groups to various blocks of countries for the years 1964 to 1970. The commodity groups were rearranged into the Puget Sound Economic Area input-output categories. The rates of growth of each of these categories were then estimated for the years 1964 through 1970, and the same rate was projected on out to 1980. While the source for the United States projections was an unofficial working paper of the United States Department of Commerce, it was felt that these were the best estimates available. Again, for some industries—notably aerospace, aluminum, and the forest products industries—no separate projections of world trade were made. Rather, these industries' outputs were determined independently, as noted above.

(3) Exports out of Puget Sound to the rest of the United States were divided into two categories: those going to California and Oregon, and those going to the rest of the United States. (Export sales to the rest of Washington were included with those to the rest of the United States. Although it would have been desirable to consider these as a separate category, it was impossible to project the level of outputs in this area separately from the rest of the United States.) This division recognized the fact that these two markets were of differential importance to the Puget Sound Economic Area. Approximately 30 percent of the export sales to the United States market as a whole went to California and Oregon in 1963. This was greater than one would expect on the basis of those states' share of the United States' population, and simply reflects their geographic proximity to the Study Area. Since the California-Oregon region is projected to grow at a faster rate than the United States average, it was useful to separate the export market into these two components.

The 1963 export sales of the various industries in the Puget Sound Economic Area to California and Oregon were determined through two procedures: (1) development of a table showing the sales of each area industry to other industries and ultimate markets in the United States, and (2) allocation of the share of these sales that goes to California and Oregon.

Recreation and Tourism Expenditures.

Businesses and industries oriented toward serving the needs for recreation and tourism are important in the Puget Sound Economic Area. However, the impact on employment and expenditures by recreationists and tourists was not measured in this Study. Available statistics do not provide an accurate way of determining, for broad industrial classes, the portion of plant investment, work force, payrolls, or value added, attributable to recreation and tourism in the Puget Sound Economic Study Area. Recreation and tourism expenditures by local residents are part of consumption expenditures in the C.S.C. input-output model. The non-resident expenditures appear in the export column.

Some indication as to the magnitude of recreation and tourism expenditures is indicated in a 1964-65 travel and recreation survey by the Washington State Department of Commerce and Economic Development and the State Highway Department. This survey found that the non-resident travelers to Washington numbered more than 8.3 million with expenditures of about $270 million. About 88 percent of the travelers came by automobile, 5 percent traveled by commercial air service, 3 percent traveled by bus, 3 percent utilized rail service, and the balance of 1 percent traveled by ferry. Where do the rest come from? This study indicated that about 22 percent of the travelers came from Oregon, 21 percent from California, and 14 percent from Canada. The balance of 43 percent of visitors originate in other states of the United States or in foreign countries. In 1965 it was found that the majority of non-resident travelers came to Washington during the summer months. The diversified and unique climate and scenery offered by the geographic location were the prime attraction for visiting the State. Analysis of summer travel in this study indicates that almost 50 percent of the non-resident travelers to the State of Washington cited one of the twelve counties in the

PHOTO 24. The Sauk River, a tributary of the Skagit River, is in the Skagit-Samish River Basin. Outdoor recreation and tourism is an important industry in terms of plant investment, work force, payrolls and retail expenditures. A 1964-65 travel and recreation survey found that nonresident travelers to Washington numbered more than 8.3 million and spent about $270 million. The diversified and unique climate and scenery in the Puget Sound Area were the prime attractions for many visitors to the State.

Puget Sound Economic Area as a destination. About 60 percent of this amount designated one of the four counties–Snohomish, King, Kitsap or Pierce (Central Division) as their trip destination. The following tabulation shows the percent of distribution of non-resident expenditures on a statewide basis:[1]

Expenditures	Percent
Food	33
Lodging	13
Transportation	17
Other retail purchases	18
Recreation	7
Miscellaneous	12
Total	100

The 1964-65 study by the State agencies also tabulated travel by Washington State residents for trips of 100 miles or more, or involving an overnight stay. On an annual basis about 9 million people traveled within the State spending about 23 million days on trips. Of the State total, 35 percent of the persons traveling indicated a county in the Puget Sound Economic Study Area as their trip destination. About 44 percent, or ten million days, were spent by all persons on these trips.

It is expected that as personal incomes increase both resident and non-resident travel, recreation and tourism in the Puget Sound Economic Area will become more intense. Many non-resident visitors come from Oregon and California. Increasing population in these states will also result in additional visitors to the Study Area. For example, population in the State of California is projected by the Office of Business Economics, United States Department of Commerce, to increase to 54 million by 2020 from an estimated 19.4 million in 1968.[2]

Labor Force and Population

The input-output technique and assumptions provided forecasts of the output and value added in each industry group. Employment estimates were generated by taking output per employee in 1963 and, after adjusting for productivity increases in each industry, deriving employment from the sales forecasts. The addition of employment in all industries provided the basis for estimating population. This was accomplished by adding an assumed four percent unemployment to the total employment to yield the labor force. The labor force participation rate or the percentage of persons in the population who are in the labor force was estimated from past data. To arrive at the estimate of population, the labor force participation rate was divided into the labor force. This technique takes into consideration net immigration to fill needed jobs. With this projection concept, jobs create the labor force which in turn creates population. Additional details of the projection methodology to 1980 is contained in the Technical Appendix to Exhibit D.

Projections by Division

The allocation of 1980 Puget Sound Economic Area output to the three divisions of the Area consituted a separate step in the projection process. For the year 1963, employment in the various industries in the three divisions was known. In projecting to 1980, it was first assumed that each industry in each division would keep its same share of the total on to 1980. Thus, for example, the North Division would be expected to capture most of the growth in the petroleum industry, while the Central Division would feel the impact of increased output in the aerospace industry. As a second step, however, as new information became available, this was incorporated into the analysis and the shares allocated to the divisions changed.

The general method was to identify those industries in each division whose output was tied directly or indirectly to the various export markets. For 1980, projected direct and indirect exports were assigned to the three divisions. The remaining or locally oriented output was assigned in proportion to the growth in exports. For the agricultural and forest products industries, the independent studies provided the divisional allocations.

PROJECTIONS FOR 2000 AND 2020

Puget Sound Economic Area

As mentioned earlier, the major task of the Study was to generate 1980 estimates. Projections to 2000 and 2020 were carried out in a different manner. For these years, few national projections

[1] Seattle Area Industrial Council, Economic Information Reports, November 1968.

[2] Department of Finance, State of California, Population Estimates for 1968, January 1969.

were available and none was in industry detail. Thus, it was not feasible to attempt to construct a full-blown input-output table similar to that developed for 1980.

For some industries, particularly those in agriculture, minerals, metals and forest products, independent projections were made by the studies represented in Exhibits A, B, and C. For the other industries, the 17 year trend rates from 1963 to 1980 were extended on out to 2000 and 2020. As with the 1980 projections, due allowance was made for technological changes and productivity increases. This trending plus independent study estimates provided the output, value added and employment estimates. Employment estimates, in turn, were utilized to project population by the same techniques used in 1980. In these later years, however, a slightly lower labor force participation rate was used. This is consistent with the past experience in the area.

Of all possible sources of error, the largest comes at the individual industry level. It has been argued that for the typical manufacturing firm, 30 percent of the products it will be producing a decade hence, are now unknown. By 2020 all the effects of technological change are impossible to account for in detail.

Divisions

For the 1980 projections output was allocated to the three divisions. The projections out to 2000 and 2020 for the divisions were made in a slightly different manner. In essence, each division's share of the industry's growth from 1963 to 1980 was projected on to 2000 and 2020. As before, where other information was available, it was incorporated into the projections. However, because of problems of disclosure, complete detail for all industries in all divisions could not be shown. Another recognized problem was the difficulty of forecasting a major change in location of large plants which could have a significant impact in the North or West Division.

The final problem concerns the interpretation of Gross Regional Product. For the overall area, this is a good indicator of the Area's income. At the division level, it is far less satisfactory. Especially for the North and West Divisions, the difference between regional product and regional income accruing to residents can be quite large.

POPULATION PROJECTIONS

Estimates of future levels of population were derived as a product of the total labor force and ratio of population to the total labor force. Total labor force is the sum of total civilian force and ratio of population to the total labor force. Total labor force is the sum of total civilian employment and unemployment. In the period 1963-2020, the population of the Puget Sound Economic Area has been projected by Consulting Services Corporation (Exhibit D) to grow from 1.9 million to 6.8 million people or an increase of 258 percent. The North Division is expected to grow 126 percent and the West Division 100 percent. The most dynamic growth is anticipated in the Central Division with a 289 percent increase in the 57-year period. The following Table 1-64 shows the population projection for the three divisions of the Puget Sound Economic Area:

TABLE 1-64. Puget Sound Economic Area. Population 1963-1980-2000-2020 (thousands)

Division	1963	1980	2000	2020
North	151.0	185.5	249.9	341.5
Central	1,603.0	2,418.9	3,882.1	6,235.5
West	116.0	122.5	169.5	232.4
Total	1,870.0	2,726.9	4,300.5	6,809.4

Source: Exhibit D, Table 1-4.

The Central Division which contains the Everett-Seattle-Tacoma metropolitan areas accounted for 85 percent of the population in 1963. By the year 2020 the portion of the population expected to be located in the Central Division will rise to about 92 percent. The importance of the Central Division to the Study Area is attributable to the dynamic economic activity which is expected to provide excellent employment opportunities. A comparison of the population density per square mile also indicates the urban character of the Central Division. The following Table 1-65 shows the anticipated change in population density in the Economic Study Area.

TABLE 1-65. Puget Sound Economic Area. Population Density per square mile, 1963-2020

Division	Square Miles[1]	1963	1980	2000	2020
North	4,252	35.5	43.6	58.8	80.3
Central	6,298	254.5	384.1	616.4	990.1
West	5,234	22.2	23.4	32.4	44.4
Total Economic Area	15,784	118.4	172.8	272.5	431.4

[1] Based on county areas in City and County Data Book, U.S. Department of Commerce, 1967.

TABLE 1-66. Puget Sound Area. Population projections by river basins[1] (in thousands)

Basins	1963	1980	2000	2020
Nooksack-Sumas	74.6	91.6	123.5	168.7
Skagit-Samish	53.8	64.2	86.5	118.2
Stillagumish	17.6	30.2	48.5	77.8
Whidbey-Camano Islands	19.9	26.9	36.2	49.5
Snohomish	178.2	302.7	485.8	780.3
Cedar-Green	976.9	1,479.0	2,375.7	3,816.3
Puyallup	324.5	449.8	721.0	1,157.7
Nisqually-Deschutes	69.6	74.9	104.5	146.5
West Sound	124.2	175.0	274.1	432.7
Elwha-Dungeness	28.3	29.8	41.0	56.6
San Juan Islands	2.6	2.8	3.7	5.1
Regional Totals	1,870.0	2,726.9	4,300.5	6,809.4

[1] Population projections determined in Exhibit D disaggregated into Basins.

Population projections by river basin indicate that the Cedar-Green River Basin will continue to account for most of the people who are expected to live in the Puget Sound Area over the study period. Table 1-66 shows the distribution of the population into eleven river basins over the period 1963-2020.

The age-sex composition of the population was derived by the demographic method which reflects age–specific fertility and mortality rates in conjunction with migration. Projected age-sex compositions for the Puget Sound Economic Area are shown in Table 1-67. For periods more removed in time from a known age-sex base the reliability of the estimates decreases. Therefore, for 2000 and 2020, it was assumed that the proportion of the total population in each age and sex group in the Study Area will closely approximate that for the nation as computed by the U.S. Bureau of Census.

EMPLOYMENT PROJECTIONS

By Divisions

In 1963 total employment in the Puget Sound Economic Area was 662,600. Of this, 7 percent was in the North Division, 87 percent in the Central Division and 6 percent in the West Division. By 2020, with an expected total employment of 2,434,000, the North Division is expected to account for 4 percent, Central Division 93 percent and West Division 3 percent. Table 1-68 shows the growth in employment in the three divisions for the period 1963 to 2020.

TABLE 1-67. Puget Sound Economic Area. Projected age-sex composition 1980-2000-2020 (Thousands)

Age Bracket	1980 Total	1980 Male	1980 Female	2000 Total	2000 Male	2000 Female	2020 Total	2020 Male	2020 Female
0-14	863.1	442.8	420.3	1,361.1	698.2	662.9	2,155.2	1,105.6	1,049.6
15-59	1,494.9	753.4	741.5	2,357.5	1,188.2	1,169.3	3,732.9	1,881.4	1,851.5
60 &Over	368.9	163.8	205.1	581.9	258.4	323.5	921.3	409.1	512.2
Total	2,726.9	1,360.0	1,366.9	4,300.5	2,144.8	2,155.7	6,809.4	3,396.1	3,413.3

Source: Exhibit D, Table V-5.

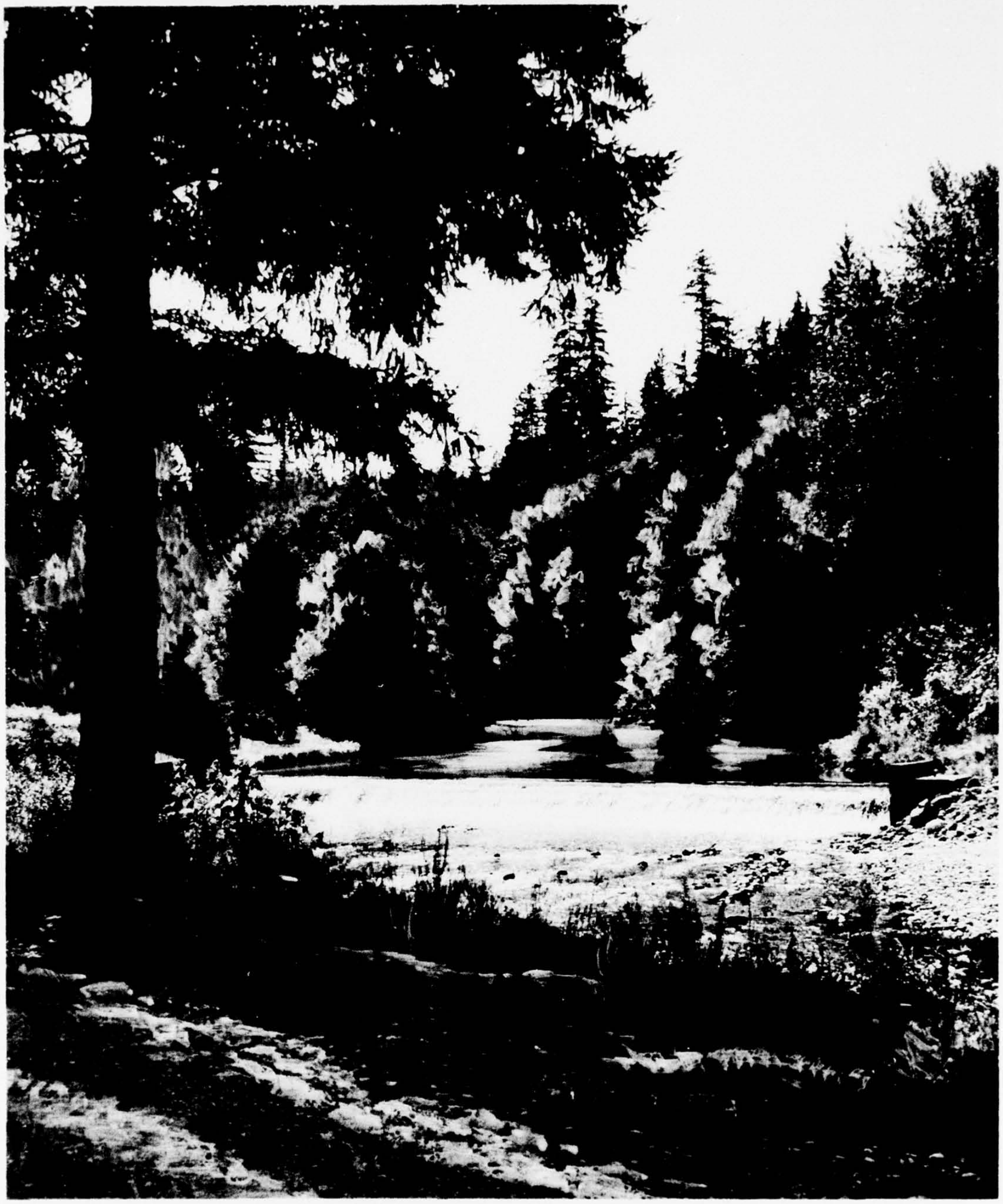

PHOTO 25. Landsberg Dam on the Cedar River is a key part of the water system for the city of Seattle. Population projections indicate that the Cedar-Green River Basin will continue to accommodate most of the people who are expected to live in the Puget Sound Area. Continuous formulation of water resource projects to accommodate future population growth is essential. In the period 1963-2020, the population of the Puget Sound Economic Area has been projected to grow from 1.9 million to 6.8 million people, an increase of 258 percent.

TABLE 1-68. Puget Sound Economic Area. Employment by division 1963-2020

Division	1963	1980	2000	2020
North	45.500	57,900	78,200	106,700
Central	579,100	873,200	1,399,800	2,248,400
West	37,700	41,900	57,600	79,500
Total	662,600	973,100	1,535,400	2,434,400

Source: Exhibit D, Table 1-4.

Over the study period the North Division is expected to increase 134 percent, the Central Division 288 percent and the West Division 111 percent. The total Puget Sound Economic Study Area is expected to increase by 267 percent in the period 1963-2020.

By Industry

Estimated future employment in each of the natural resources, commodity-producing and service type industries has previously been discussed. Only a brief discussion on each major category of employment is given here.

The natural resource industries of agriculture, forestry, fishing, and mining are expected to experience an increase in output, as well as sales to and purchases from other sectors of the economy. However, increased productivity with fewer workers is predicted due to higher mechanization of equipment and more scientific methods of growing, harvesting or extracting natural resources. In the Puget Sound Economic Area employment is expected to decline from 23,700 in 1963 to 11,000 by 2020.

Employment in the manufacturing sector was 159,700 in 1963 or about 24 percent of total employment in the twelve-county Economic Area. By 2020, manufacturing employment is expected to rise to 877,400 or about 36 percent of total employment. The most significant increase is expected in the category of "other durable manufactured products," which includes aerospace airframes and equipment, shipbuilding and repairs, machinery, and fabricated metals. These industries are rapidly expanding as the local and regional markets become large enough to permit the establishment of economical production units. Almost all industries in the Area have exceeded both the regional and national rates of increase. Two conditions, (1) the rapidly expanding local industrial and consumer markets, and (2) the importance of the export markets of other states in the United States, as well as foreign countries of the world, are expected to promote rapid expansion of these manufacturing industries. Employment in these durable manufacturing industries is projected to increase from 86,200 in 1963, to 175,700 in 1980, 380,700 in 2000 and 787,400 by 2020. Other manufacturing categories expected to account for this increase are other non-durable manufactured products, food and kindred products, paper and allied products, stone, clay and glass products, and primary metals. Manufacturing employment categories that are expected to remain stable or decline are lumber and wood products, chemicals, and petroleum refineries.

Non-commodity industries are those industries which provide services primarily to the population. Employment in local, State, and Federal government is also included in this category. The size of the population served is a major determinant of the number of workers employed in these industries. Industries included in this category are transportation, communications, and utilities; construction; retail, and wholesale trade; finance, insurance, and real estate; professional, personal and repair type service; and government. Although the recreation and tourism industry is important in the Pacific Northwest, as an industry its employment is not easily separable from the industrial categories used in this study. Its employees are found among service, trade, and many other industries of the Area. Practically all recreation and tourism employment is included in the non-commodity industry category. The basic industries such as the natural resource industries and manufacturing provide commodities to a regional, national or world market and generally set the pace of economic growth. The non-commodity industries largely serve the local market and are dependent on the level of development in basic industries. In 1963 employment in the non-commodity industries, except government, was 365,400 or 55 percent total employment. By 1980 this employment is expected to rise to 523,400 and 2000 to 781,300. In 2020 this sector of employment is forecast to rise to 1,140,200 or 47 percent of total employment. The reduction in percent of total employment over the study period is attributable to an increasing rate fo productivity of workers employed in the non-commodity industries.

Employment in all levels of government in the Puget Sound Economic Area was 115,800 in 1963 or about 17 percent of total employment. By 2020 government employment is expected to rise to 405,800. However, due to a declining rate of increase,

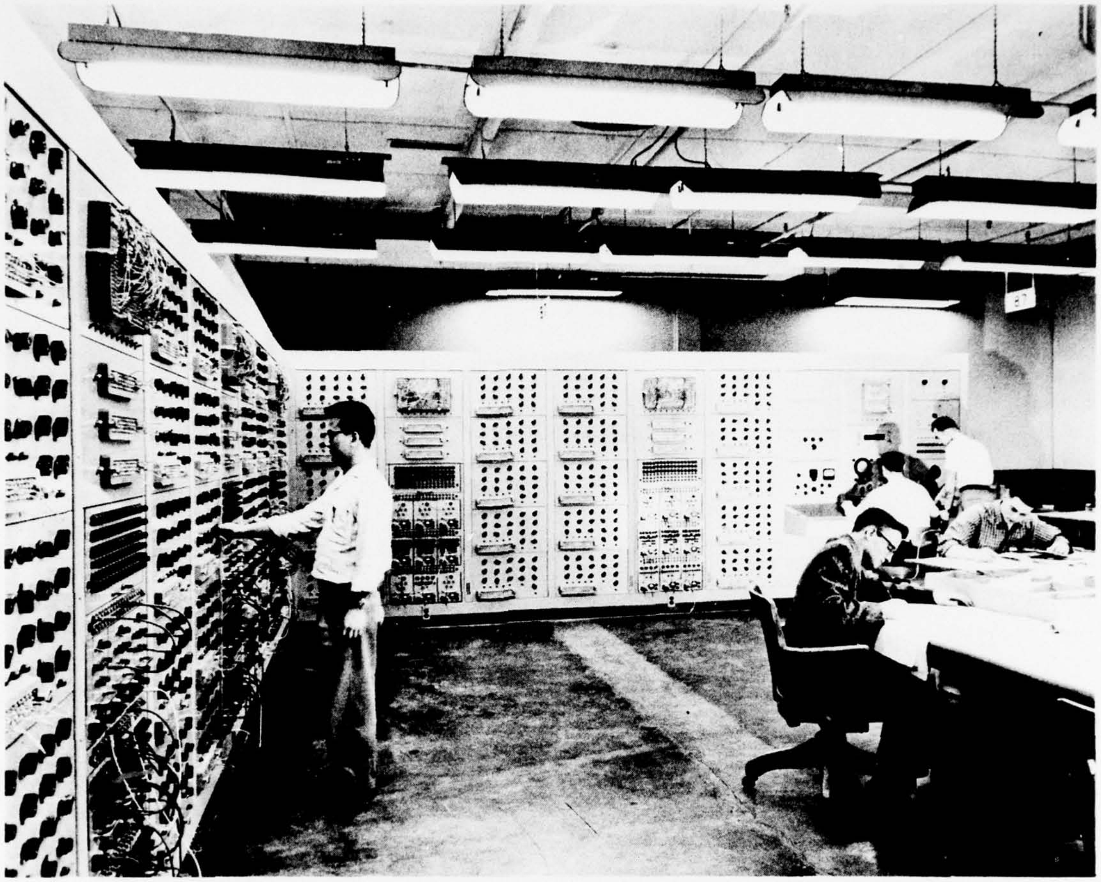

PHOTO 26. Electronic computers for solving highly technical problems as well as simple arithmetic problems of payroll and inventory are increasingly being utilized in the Puget Sound Area. These computers are being operated for the benefit of single companies as well as for many businesses and companies by computer service concerns. The utilization of computer techniques is expected to increase worker productivity in many industries. Boeing Company Photo.

government is predicted to remain about 17 percent of total employment over the study period. Employment by 15 industrial sectors for each of the three divisions can be found in Table 1-22, page 1-33.

GROSS REGIONAL PRODUCT

The term "Gross Regional Product" as used in Exhibit D is equivalent to the value added which was derived by the extensive input-output statistical study. Value added has been defined in Exhibit D as the sales of a firm less the purchase of goods and services from other firms. This differential differs from the term as used in the Census of Manufactures, U.S. Department of Commerce in that the census does not subtract purchases of service from sales.

The gross regional product as derived in Exhibit D for the three divisions during the study period 1963-2020, is shown on Table 1-69.

Gross Regional Product for the Puget Sound Economic Area is estimated to reach $68 billion by 2020. This represents 1.3 percent of projected United

States Gross National Product.[1] Gross Regional Product per capita, estimated to be $3,100 in 1963 and $4,200 in 1980, is projected to rise to $6,400 in 2000 and $10,000 in 2020. These estimates over a 57-year period from a 1963 base represent a compound interest growth rate of only 2.0 percent per year.

[1] Based on GNP as projected by OBE and adjusted to 1963 base.

TABLE 1-69. Puget Sound Economic Area. Gross regional product 1963-2020 (millions of 1963 dollars)

Division	1963	1980	2000	2020
North	$ 369	$ 848	$ 1,800	$ 3,977
Central	5,172	10,022	24,569	62,061
West	290	498	1,066	1,329
Total	$5,830	$11,358	$27,436	$68,248

Note: Figures may not add to totals due to rounding.
Source: Exhibit D, Table 1-4.

ADDENDUM

COMPARISON OF PROJECTIONS MADE BY CONSULTING SERVICES CORPORATION WITH PROJECTIONS BY OFFICE OF BUSINESS ECONOMICS FOR PUGET SOUND ECONOMIC AREA

The projections in this appendix—a "Type 2" study—were completed in late 1967 and differ in some degree with the "Type 1" study projections made by the Regional and Economics Division, Office of Business Economics, and the Economic Research Service (OBE-ERS) for the same twelve county area surrounding Puget Sound. The "Type 1" projections by water resource planning Area are contained in the report entitled, "Preliminary Report on Economic Projections for Selected Geographic Area, 1929 to 2020, Volume I, " published by the United States Water Resources Council, Washington, D.C., March 1968. The "Type 2" projections are found in Exhibit D by Consulting Services Corporation, Seattle, Washington.

Both studies recognize that regional growth will be dependent upon future national and regional economic opportunities and that the level of future regional population will respond to these opportunities. The methodology in both studies analyzes and projects regional employment opportunities and the regional population. However, the presentation of the projected economic indicators differ:

> The Type 1 study provides projections for the Puget Sound Economic Area in terms of population, income, earnings and employment in nine sectors; employment participation rate, and economic production per employee for six large water-using industries. Dollar values are in terms of 1958 dollars.
>
> The Type 2 study presents projections in terms of population, age-sex composition, employment, output and value added for 56 industries. Dollar values are in terms of 1963 dollars.

Projections in the two studies are most readily comparable in terms of population and employment. The following tabulations show the direction and magnitude of the major economic parameters of population and employment:

TABLE 1-70. Puget Sound Economic Area, population—comparison of Type 1 and Type 2 projections, 1980-2000-2020

Year	Type 1 (OBE-ERS)	Type 2 (CSC)	Difference Type 2 Over Type 1: Number	Percent
1980	2,449,700	2,726,900	277,200	10
2000	3,345,300	4,300,500	955,200	22
2020	4,448,100	6,809,400	2,361,300	35

TABLE 1-71. Puget Sound Economic Area. Total employment—comparison of Type 1 and Type 2 projections 1980-2000-2020

Year	Type 1 (OBE-ERS)	Type 2 (CSC)	Difference Type 2 Over Type 1: Number	Percent
1980	978,681	973,100	-5,581	-.01
2000	1,338,231	1,535,400	197,169	15
2020	1,773,299	2,434,400	661,101	37

The above Tables 1-70 and 1-71 show that the projections are fairly similar for the period up to 1980. However, as they extend forward in time to the year 2000 and 2020 the Type 2 projection increases at a faster rate. By 2020 the Type 2 projection indicates 37 percent more employment and 35 percent more population. The Type 1 study forecast that by 2020 the Puget Sound Economic Area would contain 1.12 percent of the total United States population. The Type 2 study predicted that the Study Area would have a 1.45 percent share of the United States population. In addition to a larger share

of national population, the Type 2 study assumed a larger United States population. The directional effect of this difference of a greater percent share of a greater United States population in the Type 2 study was that the final result was much greater than the Type 1 study. This directional effect of the difference can be attributable to the difference in assumptions, methodology, and judgment that were utilized in the projection process.

A comparision may also be made in the rate of growth between total personal income which is presented in the Type 1 study, and gross regional product, as determined by the Type 2 study. Total personal income is a major component of gross regional product. In the period 1980-2020 the Type 1 study, when adjusted to a 1963 base, forecast a 4¼ percent average annual rate of growth in total personal income in the Puget Sound Area. The Type 2 study projected a 4½ percent average annual rate of growth in gross regional product.

Comparison of Major Differences in Assumptions

Generally, most of the assumptions made in both the Type 1 and Type 2 projections are quite similar. However, there is some divergence in a few of the major assumptions, such as:

1. Population of the United States

Year	Type 1 (OBE-ERS) (000)	Type 2 (CSC) (000)	Difference Type 2 Over Type 1
1980	234,193	259,584	10%
2000	306,757	338,219	9%
2020	397,562	469,126	15%

The directional effect of this assumption is to provide for higher population and employment projections for the Type 2 study. If both the Type 1 and Type 2 studies had identical United States population projections, or if the assumptions were reversed (Type 1 taking the high United States projection, and Type 2 study taking the low projection), especially for 2000 and 2020, the magnitude of the difference would probably not be as great.

2. The Type 2 study explicitly assumed that there will be a continued relaxation of trade tariffs and quotas and an accompanying expansion in international commerce. The statistical technique used in the Type 1 projection implies that tariffs and quotas will be the same in the future as they have been in the past unless included by judgment in extrapolation of the industry curves. The trend toward the concept of "common markets" and activities of the International Monetary Fund and World Bank to open lines of international commerce may be expected to relax trade tariffs and quotas. Puget Sound ports are expected to benefit from the economic expansion of countries surrounding the Pacific rim and other countries located in Europe, Asia and Africa. The directional effect of this assumption would be to increase the employment opportunities and consequently the employment and population projected in the Type 2 study.

Methodology

One of the reasons for the divergence in projections between the Type 1 and Type 2 studies for the Puget Sound Economic Area is the difference in the statistical methods utilized to obtain the future trends. The Type 1 study used a variation of the "shift-share" analysis and the Type 2 study utilized a regional interindustry input-output analysis. The directional effect of the difference in statistical methods cannot be accurately appraised. The most significant difference in the projections occur in the 2000 and 2020 periods when substantial judgmental projections were combined with the statistical methods in both the Type 1 and Type 2 study. The two statistical methods are outlined below:

1. Type 1 (OBE-ERS)

The variation of the "shift-share" analysis began with projections of the overall economy in terms of national aggregates such as gross national product, income, population, labor force, rates of productivity and unemployment. Regional projections were developed for 167 study areas, each of which formed a complete and integrated economic unit characterized by comparative stability in interindustry relationships. These 167 economic study areas were divided into over 200 Water Resource Planning Areas, one of which was the Puget Sound and Adjacent Waters Study Area. For each economic area, regional income, earning and employment projections were developed. The population projection was a derivative result by the application of predicted ratios of employment to population.

To obtain projections of say, employment in a region for a particular industry, the analysis began by identifying an aggregate national growth rate of total employment, with the assumption that all regions and industrial sectors should have at least this growth. This is the national growth component or the "share" for the region. The remaining growth represented a net gain could be due to a favorable distribution of fast growing industries or due to the fact that the industries in the region are in a better competitive position and are growing faster than the same industries at the national level. The Type 1 "shift-share" analysis used 1960 values to allocate the national totals of gross product by industry into the 200 Water Resource Planning Areas. The components of income and of employment in each region were expressed as percents of the corresponding United States total. For income, percentages were calculated for 1929, 1940, 1950, 1962 and in some instances, 1965. For employment, the years used (reflecting data availability) were 1930, 1940, 1950, 1960, and, for certain industries, 1962 and 1965.

The percentage shares of each component in each region (more than 13,000 series) were plotted on semi-logarithmic graph paper. A trend line was fitted to the data in each instance and extended to 2020 arithmetically. Next, the historical trend of the regional shares of each component was analyzed. Mindful of these analyses and adjustments, the projections to 2020 produced by the statistical technique were modified with "substantial judgment" entering the process in determining the shape of both the historical and projected curves.

2. Type 2 (CSC)

The method utilized in projecting economic activity to 1980 in the Type 2 study for the Puget Sound Economic Area is known as input-output analysis. The 1963-1980 trend line established by this technique was extrapolated to 2000 and 2020. Input-output represents an approach for depicting and investigating the underlying processes which bind together the regions of a system and the separate facets of their economies. It provides detailed presentation of: (1) the production and distribution characteristics of individual industries, (2) the nature of the interrelationship among these industries and other economic sectors. The input-output analysis presents the interrelationship of industries in terms of sales and purchases. A major factor in choosing this method for the Type 2 study was the availability of a projection model developed by the University of Washington for the Washington State Department of Commerce and Economic Development. The study developed a computerized model for the State of Washington for 1963 by 56 industry categories. This model was adapted to the Puget Sound and Adjacent Waters Area and became the base for projections. The 1963 interindustry sales and purchases became a base for a major projection effort focused on the year 1980. The 1963-1980 trend rates were extended to 2020 with "substantial judgment" with allowance for technological changes and productivity increases in terms of output, value added and employment. The projections developed future industrial output which in turn was converted to the number of employees or workers necessary for the production of that output. The availability of jobs in turn was converted into projected population.

In the projection process, account was taken of changes in technology, expected local production of goods now imported into the area, productivity increases, labor force participation rates, changing pattern of consumer behavior as per capita incomes increase, and emergence of new industries. The supply of raw materials available to certain industries was considered, such as with forest resources.

Comparison of Major Differences in Methodology

1. The Type 1 study used trend lines from 1929 to 1965 for regional population, personal income, earnings and employment where data were available and extrapolated the historical trend line to 2020 with "substantial judgment." The Type 2 study used 1963 as a base and provided projections to 1980 by an interindustry computerized input-output model. This 1963-1980 trend line was extrapolated beyond 1980 to 2020 by judgment. With one study utilizing 1929 to 1965 trend lines and the other using 1963 to 1980 trend lines for extrapolation purposes, the 1963-1980 trend would tend to show more rapid growth than the 1929-1965 trends due to the influence of the depression period of the thirties. The directional effect of this method would tend to make the 1963-1980 trend line (Type 2 study) more optimistic.

2. The Type 1 procedure is dependent on what happended in the nation, and splits the national totals into over 200 regions, whereas the Type 2 method concentrates on what happened in one region. The

Type 2 study, with an intense investigation of the region, had the capability of taking more economic growth factors into consideration.

3. The Type 1 study assumed that each of the 167 economic study areas were closed trade areas (closed place theory), in which the number, size, and type of establishments and their trade areas were bound together by relative transportation costs. Final projections of residentiary industries were determined endogenously and projected together with changes in the exogenous sector. In the projections for the Type 2 study, particular attention was given to the market areas outside the Study Area such as: exports to foreign countries, neighboring states, and the rest of the United States. One of the reasons for a prosperous outlook was due to the fact that California and Oregon are good customers of the Puget Sound Economic Area. California is expected to grow at a rate faster than the national average and be home for about 54 million people by 2020. The Type 2 study also placed emphasis on the geographic location of the Puget Sound Economic Area in relation to the North Pacific trade routes by water and air modes of travel to the underdeveloped markets of Asia and other countries around the rim of the Pacific Ocean. The directional effect of this assumption is difficult to assess due to the unknown weight applied in the judgment process in each study.

4. A basic assumption embodied in the regional projections by industry for the Type 1 study was that trends will be continued into the future until altered by external forces, such as depletion or discovery of exploitable resources or the imposition or removal of economic hindrances or stimuli in the form of laws and customs. The statistical technique of the interindustry input-output model used in the projections by Consulting Services Corporation assumed that trends may be changed by both internal, such as supply and demand shifts, and technological improvements, and external forces. The impact of this directional effect is probably not too significant by the year 2000 and 2020, but there is a tendency for the assumption to provide for higher employment and population projections.

5. The Type 1 procedure has been described as a rational and orderly method for sorting out the factors which relate to the differences in the historical rates of economic growth among regions. National supply conditions are considered and technological changes and locational shifts are recognized in a shift-share analysis, but are generally given more weight in an interindustry input-output analysis. The results of these differences in assumptions and procedures are generally to provide for higher projections in the Type 2 study. The 1980 projections are similar due to the availability of adequate input information utilized in short-term projections. The role of the different statistical methods and substantial judgment used in each study both contributed to the divergent projections for the 2000 and 2020 study periods. The Main Report and Appendix XV, Plan Formulation, include an evaluation of the impact of the lower level projections by OBE-ERS on the water resource plans developed for the area.

Exhibit A
Projected Agricultural Economy

EXHIBIT A

AGRICULTURAL ECONOMY
OF THE
PUGET SOUND AND ADJACENT WATERS AREA

PROJECTIONS 1980 – 2000 – 2020

Prepared for
PUGET SOUND TASK FORCE of the PACIFIC NORTHWEST
RIVER BASINS COMMISSION

By
Economic Research Service

U. S. DEPARTMENT OF AGRICULTURE

September 1967

PREFACE

In 1964, Congress authorized Federal participation in a comprehensive study of the water and related land resources of the area of northwest Washington, later designed as Puget Sound and Adjacent Waters. The Columbia Basin Interagency Committee delegated responsibility for the study to its newly-established subsidiary, the Puget Sound Task Force, Representatives for the State of Washington and several Federal departments comprise the Task Forece. Within this organization, Economic Research Service serves as one of the Federal study participants. ERS has major responsibilities for the analysis and projection of the regional agricultural economy and related sectors and for the analysis of agricultural water problems and appraisal of needs for rural resource development.

The purpose of this report is twofold: (1) to provide a useful reference for all interested study participants, and (2) to summarize available data related to the present and recent past activity of the agricultural sector of the Puget Sound Area. Information is included regarding agricultural use of land and water, employment in agriculture, rural population, and output and sales of agricultural products. The following report incorporates a general analysis of recent trends in the rural agricultural economy. Those interested in further analysis and in projections of future activity are referred to Exhibit D, Puget Sound and Adjacent Waters, Projections 1980-2000-2020 by Consulting Services Corporation, January 1968.

EXHIBIT A

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PROJECTED AGRICULTURE ECONOMY

SUMMARY

While a broad range of farm products is produced in the Puget Sound and Adjacent Waters Area, most of the farm output is accounted for by a few major commodities, Table 1.

Recent estimates of agricultural activity in the Area have indicated that significant increases in production are anticipated for vegetables, berries, broilers, eggs and milk. The estimated percentage increases in production for the major commodities are shown in Table 2. The most significant increase is in vegetable production. Vegetable production is expected to increase by an estimated 250% by 2020.

TABLE 1. Value of production of selected commodities PS&AW 1963[1] with projections to 1980, 2000 and 2020.

	Production			
	1963	1980	2000	2020
	$1,000	$1,000	$1,000	$1,000
Vegetables	10,699	19,283	27,610	37,838
Berries	8,400	12,740	17,231	21,751
Broilers	7,456	10,982	14,807	18,020
Eggs	18,405	25,767	34,707	46,695
Milk	53,084	67,223	88,794	116,721

[1]Estimated from Census of Agriculture and Statistical Reporting Service U.S.D.A.

TABLE 2. Indices of production for selected commodities PS&AW 1963[1] with projections to 1980,2000 and 2020.

	Projections[2]		
Commodity	1980	2000	2020
	Percent	Percent	Percent
Vegetables	180	260	350
Berries	152	205	260
Broilers	147	199	240
Eggs	140	188	250
Milk	127	167	220

[1]Estimated from Census of Agriculture and Statistical Reporting Service, U.S.D.A.

[2]Projections are indices of physical volume, 1963=100.

Total value of crop and livestock is projected to increase from $128 million in 1963 to $165 million by 1980 and to $274 million by 2020, Table 3. This growth in crop and livestock output represents a 29% increase by 1980 and 115% increase by 2020. The production of livestock products is expected to continue to be the dominant industry in agriculture. The Area's projected estimates have indicated that the total value of livestock products should exceed $200 million by 2020.

TABLE 3. Production of farm products PS&AW 1963[1] with projections to 1980, 2000 and 2020.

Product class	1963[1]	1980	2000	2020
	$1,000	$1,000	$1,000	$1,000
All crops	30,328	40,250	50,071	61,967
All livestock	97,310	124,629	163,353	211,862
All farm products	127,638	164,879	213,424	273,829

[1]Estimated from Census of Agriculture and Statistical Reporting Service, U.S.D.A.

Associated with the projected increase in total agricultural production, including nursery, horticultural and other miscellaneous products, the total cost of purchased inputs is expected to increase by an estimated 23%—from $81.5 million to $100.5 million— between 1963 and 1980. This may be compared with a 33% increase in value of production. In contrast, value added by capital labor and land inputs into agriculture increase by an estimated 48%—from $54 million to $80 million—over the same time period.

Other changes that are projected to occur in the regional agricultural economy after 1963 are projected to occur in the regional agricultural economy after 1963 are shown in Table 4. Significant decreases in the total number of farms, farmland, rural farm population and farm employment are expected by 2020. Changes in the total number of farms and farm rural population represent the largest declines in the region. The total number of farms and rural farm population is estimated to decline by 66% and 67%, respectively, by 2020.

TABLE 4. Indices of selected characteristics in agriculture, PS&AW 1963[1] with projections to 1980, 2000 and 2020.

Item	Projections[2] 1980	2000	2020
	Percent	Percent	Percent
Farmland	78	58	44
Number of farms	60	45	34
Rural farm population	58	43	33
Farm employment	74	52	31

[1]Estimated from Census of Agriculture.

INTRODUCTION

The agricultural economy of the Puget Sound and Adjacent Waters Study Area[1] provides an interesting subject for the study of agricultural development in small regions. The following study was developed to project future activity in terms of quantity and value of agricultural production, crop acreage, land use, farm numbers, rural farm population and employment. In addition, the study provided projections of input-output relationships in agriculture. While the primary purpose in developing these data has been to provide a base for planning the long-term development of the region's water and related land resources, this report serves as a guide to the methodology employed in the study. As such, it may find wider application among analysts interested in regional growth in agriculture and other resource-based industries.

The use of projections is a necessary element in formulating plans for future resource development. Yet, popular fascination with and possible over-dependence upon the numbers may pose a real threat to sound planning. Analytically, it is important to understand the reasoning which is implicit in projections; the anslysis incorporated in the development of projections is more meaningful in terms of understanding changes in economic activity than the numbers which are derived. For this reason, greatest emphasis has been placed upon methodology in this report.

[1] The Study Area was defined for the purposes of this study to be comprised of the following 12 counties in Northwest Washington: Clallam, Island, Jefferson, King, Kitsap, Mason, Pierce, San Juan, Skagit, Snohomish Thurston, and Whatcom.

METHODOLOGY FOR PROJECTIONS OF ECONOMIC ACTIVITY

In the study of regional economic growth, a careful analysis can yield an identification of the controlling factors which have shaped the region's economy—those factors which have determined the region's relative supply and market positions in the past. However, defining specifications of the determinants of regional development for projective analysis is a far more delicate matter. It is one thing to state the causative relationships between the important independent and dependent variables; it is another to project the future behavior of the system's parameters. While some independent variables exhibit a high degree of stability over time, others react in a volatile manner in the long run. The analyst is given a choice between two basic alternatives: (1) he may choose to apply a system of economic behavior functions—accepting the risks associated with wide ranges of variability in the behavior of certain parameters, e.g., changing tastes, productive technology, and relative prices—, or (2) he may choose to adopt a simpler time—series model sacrificing the model's interpretive value. It is most likely that the analyst will develop a mixed strategy, employing both functional and time-series regression estimates of relavant variables.

However, operational considerations are likely to dominate the analyst's approach to long-run projections with a preference for predictability outweighing the desire for precise specification of economic relationships.

The analytical approach adopted in the Puget Sound study was developed slowly. There was no a priori commitment to a specific methodology; instead, the procedures were derived from the process of analysis. One assumption provided a general framework for the study, i.e., it was assumed that agricultural development would have to be consistent with overall economic development of the region (the particular implications drawn from this assumption will be detailed in the subsequent discussions).

Using 1963 as the base year, it was established early that agriculture was relegated to a minor role in the regional economy, e.g., agriculture contributed 1% to the regional product and 3% to the total employment.[2] A Study of past development of the

[2] Exhibit D.

region provides a general explanation—agriculture competes at a disadvantage with urban and industrial uses at the intensive margin, and forestry and related land uses dominate the extensive land use pattern. Thus, agriculture is caught in the middle with little apparent ability to expand. The resultant position of the region's agricultural economy can be clearly summed up by means of a location quotient using 1959 data on value of sales and 1960 population data. Puget Sound agriculture can be represented by a location quotient of 1.27.[1] It appeared obvious, therefore that the region was a net importer of agricultural commodities. This characteristic of the region's agricultural economy indicated that there was a little rational basis for assuming the existence of stable, long-run relationships between regional output and national production. The conclusion was drawn that a regional share model would be inappropriate for developing output projections. Subsequent analysis was based largely upon examining the implications of various hypotheses regarding intra-regional relationships.

An examination of past behavior in the production of major commodities provided a point of departure. The following six commodities were identified as dominating the total output mix—vegetables, berries, hay, milk, eggs, and broilers. Moreover, the Puget Sound Area was found to be a relatively important contributor to total state output of these commodities. The 1963 Area's share of Washington production were estimated to be as follows: 38% of vegetables, 68% of berries, 15% of hay, 68% of broilers, 64% of milk, and 62% of eggs.[2] Using available Statistical Reporting Service data for the period between 1954 and 1963 (with at least 6 consecutive years in each case), time-series regressions were developed for production of vegetables, hay, and berries for both the region and the State and for output of milk, eggs, and broilers for the State only. With regard to berries, milk, eggs, and broilers, those products for which the Puget Sound Area accounts for more than 60% of Washington output, a high degree of mutual intercorrelation exists between the Area and the State. Since the regional share of total output has remained relatively stable over time; the estimates derived from time-series regressions of State production were assumed to be an acceptable proxy for extrapolating Puget Sound output to 1980. In the case of vegetable production, a regression model relating regional output to State production for the time period studied yeilds an r^2 of 0.96, providing further evidence of inter-relation. Thus, time-series projections were prepared comparing an independent regression estimate of Puget Sound output to one dependent upon total Washington production. Finally, regression analysis of hay production for the State and Area indicated a relative degree of independence (an r^2 of 0.37) between the two variables. As a result, time-series projections of Puget Sound hay production were developed indendently.

In order to round out the analysis of disaggregated production, a study was made of changes in output of all commodities, using Census of Agriculture data for 1954, 1959 and 1964. Past trends in quantity of output and value of sales were extrapolated to 1980. As a test for consistency, the projected changes were compared with those derived from the regression equations generated from SRS data and were found to be generally of the same order. This analysis provided evidence for a general observation regarding the changing composition of the regions agricultural economy. Those commodities not included in the analysis, e.g., small grains, tree fruits, pork, and wool, were of minor importance and were steadily declining in significance. Thus, there were strong indications of a growing specializtion in vegetable, berry, poultry, and dairy enterprises within the Area's economy. It was concluded that whatever the levels of future output might be, the composition of output would reflect this trend towards increased specialization.

The subsequent steps in the analysis of the Area's agricultural economy were taken in order to relate present and future development to exogenous factors which should be expected to influence growth. It was necessary to explain the competition between agriculture and all other activity for the Area's supply of economic factors of production and competition between the Area and alternative sources of supply for the relevant markets for agricultural output. In this analysis, the allocation of productive land was identified as the most important of the economic factors to be examined—the total supply of

[1] The location quotient expresses the relative concentration of an industry in a region as compared to the nation as a whole. If, for example, the region's share of national industrial output was strictly proporational to its share of national population, the location quotient would equal 1.00.

[2] Estimates derived from data provided by Statistical Reporting Service and Census of Agriculture.

land available for use is bounded, whereas the total supply of labor, although an important factor, is not constrained. It was assumed that the relative ability of agricultural acitivity to compete for land use could best be represented by net changes in land in farms, cropland, and pastureland. The trends in agricultural land use were examined for the period between 1940 and 1964. For the time period following 1950, there was evidence of a steady decline in total farm land and in the separate crop and pasture land components. Because it had been assumed that future urban development and industrial growth would follow closely the pattern of the recent past, the trends in land use were projected to continue as given by the rates of change between 1954 and 1964.[1] Moreover, the projected changes in the major components of agricultural land use were found to be consistent with the projected change in total farm land, with crop and pasture land uses becoming more dominant over time. The projection of cropland for the Area was assigned the role of constraint to total crop acreage for the projection period. Thus, output projections could be related to the overall levels of economic activity in the region.

The net ability of local producers to compete with suppliers from outside the region was analyzed by means of location quotients, as explained above. All major commodities were assigned to one of three categories, which represented different levels of market potential as follows: (1) for products represented by a quotient of less than 0.50, the Area was assumed to be a net importer, with local producers acting as a marginal supplier to the regional market; (2) for products represented by a quotient within a range of 0.5 to 1.2, the Area was assumed to be nearly self-sufficient, with demand related directly to the regional market; (3) for products represented by a quotient exceeding 1.2, the Area was assumed to be a net exporter, with national demand influencing output. Applying this logic, two commodities were identified as exports—vegetables and berries for processing, with location quotients of 1.5 and 7.0 respectively. The outputs of milk and eggs were classed as self-dufficient since the quotients for these products were both nearly 1.0; broiler production was classed as nearly self-sufficient with a location quotient of about 0.7. All other commodities fell into the category of net imports.

Final projections of products were finally generated utilizing the framework of analysis as developed. First, vegetable and berry outputs were projected on the basis of projected increases in national consumption, derived from assumed changes in population and per capita consumption.[2] Further justification for such a procedure is given by the evidence of real competitive advantages in the production of strawberries, raspberries and green peas, which represent 82% and 63% of total regional berry and vegetable acreage respectively.[3] The regional projections of vegetable and berry output were used to generate projections of cropland acreage by adjusting current normal yields for assumed increases in productivity.[4] Second, the projections of milk, eggs and broilers were generated from the assumed projections of regional population, applying national estimates of changes in per capita consumption; these projections proved to be nearly the same as those derived from the time-series analysis previously completed. Third, projections of acreages of all other crops were developed by fitting the previous projections of output to the cropland acreage constraint, less the projected vegetable and berry acreages determined independently. Changes in output yields were utilized in relating future production to cropland acreage.[5] Finally, projections of all other livestock products were developed from the trend analysis with some modification to account for beef production as a by-product of the dairy sector. Aside from the case of forage production and acreage, the projected outputs of all those commodities which were not directly related to changes in national or regional

1 Exhibit D.

2 Preliminary unpublished projections developed by the U.S. Department of Commerce and Agriculture under the auspices of a program "Economic and Statistical Analysis and Projections for Comprehensive River Basin Planning" sponsored by the Water Resources Council.

3 Washington Agricultural Statistics, Berry Crops May 1965. H. M. Hutchings and C. B. Davis, Estimated Costs of Producing Green Peas, Circular of Information 601, Agricultural Experiment Station, Oregon State College, February 1960.

4 Adon Poli, "Long-term Production Prospects for Western Agriculture," U.S.D.A., Agricultural Economics Report No. 33, RPED–ERS, May 1963.

5 Poli, op. cit.

demand proved to be relatively insignificant. Because the production of these commodities appears to be marginal, the procedure adopted would seem to be reasonable since marginal operations are the most likely to be affected by urban and industrial growth.

The procedure for generating projections to the periods 2000 and 2020 were, of necessity, less rigorous. Essentially, they were developed by extending the 1963-1980 trends, with the constraint upon total land available providing a dampening effect to expansion. Thus, land available for agricultural production is assumed to play a significant role in shaping the development pattern over the long-run; again, this seems to be a reasonable approach for treating growth patterns in a small growing metropolitan region.

METHODOLOGY FOR INPUT-OUTPUT ANALYSIS

The analysis of the Puget Sound Area was highly dependent upon the recently completed interindustry study of the State of Washington. For the year 1963, a 54-sector purchase and sales flow model of the State's economy was developed by a group of researchers from the University of Washington. Both the final product and many of the unpublished working papers were made available for generating *the Puget Sound model.*

Under normal circumstances it is necessary to gather a wealth of primary data on the purchase and sales characteristics of individual industries. This task can only be accomplished by a comprehensive survey of producers and suppliers. Since the Puget Sound Area is responsible for roughly two-thirds of total State economic activity, however, it was possible to use the State framework for determining upper limits to the relative size of flows. While differences might arise related to the factor of import substitution because of differences in the industrial structure of the region as compared to the State, the primary concern in modifying the agricultural sectors was that proper account would be taken for differences in output composition. Thus, the first step in developing Puget Sound interindustry flows was the identification of differences in sectoral composition. This had previously been accomplished during the projective analysis phase of the study.

Next, estimates of interindustry flows and value-added characteristics were developed for major commodities within each of the agricultural sectors, e.g., green peas, sweet corn, lettuce, snap beans, strawberries, and raspberries for the fruits and vegetables sector; hay and small grains for the field crops sector; milk, eggs, and broilers for the livestock sector. Two major sources of data proved invaluable for this undertaking. Enterprise budgets prepared by the Agricultural Extension Service of Washington State University and interview data gathered from food processors, producer's associations, and commodity specialists provided the basis for input costs and output markets.

Estimates of total flows for the aggregated sectors—fruits and vegetables, field crops, livestock products, and specialty products—were developed by summing the data for individual commodities within each sector and factoring the results to account for the contributions to total sector output of those remaining commodities not included in the disagregation. Some modifications were necessary to adjust the estimates to agree with available secondary data on aggregate flows.[1] SRS data and various commodity commission accounts were available in some instances for sales and utilization of output data. Census of Agriculture and State farm income data provided additional detail regarding purchases, such as fertilizer, feed and petroleum. The data derived from the preceding analysis were sufficient to derive preliminary estimates of the technical input-output coefficients for each of the agricultural sectors.

The final work on the 1963 interindustry model was undertaken to explain the relationship to extra-regional sources of supply and export markets of Puget Sound output. First, the residentiary or marked-oriented industries were identified; for these industries, the total purchases of inputs were allocated to regional suppliers. Second, the relative concentration of basic industry was determined from unpublished data of the Washington interindustry study, information provided by processor-suppliers, and data from the Census of Manufactures. Where appropriate, purchases of inputs were reallocated

[1] Modifications were required since available secondary data covered only portions of the inputs used in the analysis.

from the interindustry matrix to the import sector.[1] In addition, the contributions of local trade and transport services were accounted for by allocating margins from the estimated quantities of purchased input to the service sectors, according to data from the Washington input-output study. Thus, the final transactions matrix was developed by successive adjustments to the preliminary table of technical coefficients.

The projected 1980 input coefficients were developed directly from the 1963 data. The Washington study provided certain guidelines regarding changes in productivity and in import substitution. The latter factor was largely irrelevant, however, because most suppliers could be placed into one of two categories either, the supplier was market-oriented, implying little prospect of changes in import-export relationships, or the supplier was resource-based, also implying a lack of prospective changes in spatial patterns of location. In order to adjust the coefficients for changes in productivity, the analysis rested heavily upon the projection of Adom Poli.[2] Factors of production were classified as either "extensive" or "intensive". Those in the former group are dependent upon total levels of output and are not likely to show effects from increased productivity. Those factors in the latter group are amendable to changes in marginal product. Most "intensive" input coefficients were reduced to reflect on adoption of current optimum levels of technology; data provided by commodity specialists were utilized for developing these adjustment. One overall check on the reasonableness of net productivity gains was provided by the implied change in value-added per employee, information from the Washington input-output study was utilized for this analysis.

[1] Several of the inputs were reallocated on the assumed basis of being locally produced. Forest product inputs were included in this category. Service inputs were generally considered as being produced locally. In pust of feed grains and much of the forage were assumed to be imported. Chemicals, fertilizers, and other petroleum products were allocated on the basis of PS&AW relative share of the State totals. It should be noted that machinery was included with capital consumption in this analysis.

[2] Poli, op. cit.

REPORT FINDINGS

In the sections of this report which follow, the results of the projective and input-output phases of the study are recorded. In addition, projections were developed for population, employment, and numbers of farms on the basis of trend analysis; projections of these factors were related to the projections of land use and output for internal consistency of the study. In this regard, additional comments on general methodology are included in the text.

Land Use

In the Puget Sound Area, about 1 million acres, or approximately 10% of the total land area, is land in farms. In contrast, 45% of the total land area in the State is classed as land in farms. This relatively low concentration of agricultural land in the Area is to be expected since the Puget Sound Area contains the largest single urban-industrial complex in the Pacific Northwest. Recent declines in the amount of farmland in the Area have been associated with urban population growth and industrial expansion.

In 1963, the allocations of farmland to major uses were as follows: (1) cropland–486,000 acres, (2) pastureland–289,000 acres, (3) woodland–221,000 acres, and (4) other land–57,000 acres, Table 1. In that year the central subarea contained 402,750 acres; the north had 393,750 acres, and the west contained 257,000 acres of land in farms. Between 1950 and 1963 the total land in farms for the Area declined 23%; cropland declined 17%; pastureland declined 20%; woodland declined 33%; and other land declined 41%. During the same period, the net shifts of land out of agricultural use represented 18% of the farmland in the North Division and 26% of the farmland in the Central and West Divisions.

Because of the natural locational advantages of the Puget Sound Area as a locus for shipping and other commercial and industrial activity and because of its further advantages of building upon an existing industrial concentration, it is most reasonable to assume that future growth of the Pacific Northwest will result in the intensified development of the entire Puget Sound Area. Since 1940, the land area in incorporated and unincorporated places with population densities greater than 1,000 persons per square mile has increased by an amount in the order of

TABLE 5. Acreages of land in farms—PS&AW 1963 with projections to 1980, 2000, and 2020

Land Use	Current Acreage 1963[1]	Projected Acreage 1980	2000	2020
	Acres	Acres	Acres	Acres
Lands in farms:				
North	393,750	334,000	279,000	233,000
Central	402,750	294,000	182,000	116,000
West	257,000	195,000	147,000	111,000
PS&AW	1,053,500	823,000	608,000	460,000
Cropland:				
North	238,250	207,000	189,000	162,000
Central	162,750	101,000	61,000	30,000
West	85,000	59,000	49,000	33,000
PS&AW	486,000	367,000	299,000	225,000
Pastureland:				
North	72,600	68,000	55,000	53,000
Central	125,600	96,000	73,000	61,000
West	90,800	66,000	63,000	62,000
PS&AW	289,000	220,000	191,000	176,000
Woodland:				
North	61,900	56,000	27,000	13,000
Central	90,200	82,000	39,000	19,000
West	69,400	62,000	30,000	14,000
PS&AW	221,500	200,000	96,000	46,000
Other land:				
North	21,000	13,000	8,000	5,000
Central	24,200	15,000	9,000	6,000
West	11,800	8,000	5,000	2,000
PS&AW	57,000	36,000	22,000	13,000

[1] Estimated from Census of Agriculture

150,000 acres.[1] The amount of land taken for all urban uses—residential, commercial, and industrial—has been considerably larger. Much of the land shifted to urban use is land that formerly sustained some agricultural use.

Two characteristics seem to be dominant in the analysis of change in land in farms—first, the stability of the rate of decline in all farmland, and second, the steady increase in the proportion of land used for crops and/or pasture. On the strength of expectations for overall changes in regional land use, it has been assumed that these trends will continue, with only slight modification. On this basis, the quantity of land in farms has been projected to decline as shown in Table 3. Of particular importance are the following compositional changes projected: (1) the greatest absolute and relative shift in land use will occur in the Central Division; (2) the proportion of farmland use either for crops or for pasture will increase substantially; and (3) the North Division will contain the major share of land in farms. On the basis of past experience, the area most vulnerable to land use shifts has been on the periphery of the Seattle-Tacoma-Everett metropolitan complex in the Central Division. In addition, the net shifts of land out of agricultural

[1] Estimated from data included in 1960 Census of Population.

activity have occurred most frequently on the extensive margin, i.e., land employed in uses other than for crop or pasture production.[1]

Number of Farms

The number of farms in the Puget Sound Area has declined at an approximate rate of 4% per year since 1954. This stands out, as it is a rate of decline nearly double that of the entire Pacific Northwest. The difference is largely due to losses of farmland in the Puget Sound Area since the Pacific Northwest has experienced slight increases in land in farms over a comparable time period.

While declines have occurred in the number of farms in all sizes, nearly 90% of the reduction can be found in units of less than 50 acres. Since 1954 the annual rates of decline range from 13.7% for farms of less than 10 acres to just 0.5% for farms greater than 260 acres in size. The result has been to increase the size of the average unit from 49 acres to 64 acres, an increase of 31%.

In the 10 years following 1954, some changes have taken place in the number of farms by major type.[2] The greatest change in farm numbers by type has been the 71% decline in poultry farms in the Puget Sound Area. Since poultry output has actually increased, however, the change in number of farms reveals a considerable trend in concentration of production, resulting from consolidation and internal growth among the large production units. While the number of all farms declined 44%, the number of livestock farms increased 29%; this change represents the greatest deviation from the general trend.

The change in number of all other classifications of farms were not significantly different from the average of all farms; these changes ranged from a 40% decrease in general and miscellaneous farms to a 54% decrease in dairy farms. By 1963, the largest classification by number of farms was the general and miscellaneous category, followed in order by dairy farms, livestock farms, vegetable, fruit and nut farms, poultry farms, and field crop farms.

A review of changes in number of farms by economic division shows the greatest absolute and relative decline has occurred in the Central Division. The North Division has experienced a slightly greater rate of reduction in farms numbers than the West Division, despite the fact that the rate of decline in farmland is less for the North Division. Thus, the West Division, which has the largest average farm size, exhibits a lower propensity for consolidation of farms into larger units. This evidence might be taken to indicate that the marginal gains which accrue to larger units from economies of scale, particularly from more intensive use of management and capital, tend to decrease with size. Farm consolidation may become, therefore, a less powerful influence on number of farms in the future.

The projections of number of farms (shown in Table 6) indicate a continuing, but less rapid decline. As the change in farm size distribution continues, the large loss in farms of less than 50 acres will weigh less heavily. Moreover, the incentive for consolidation will probably be less influential as the average size of farm increases. Thus, the most important factor in determining changes in farm numbers will be changes in the amount of land in farms.

TABLE 6. Number of farms. PS&AW 1963 with projections to 1980, 2000 and 2020

Division	Number of Farms 1963[1]	1980	2000	2020
	Number	Number	Number	Number
North	5,050	3,380	2,800	2,350
Central	7,520	3,900	2,550	1,750
West	2,450	1,770	1,350	1,000
PS&AW	15,020	9,050	6,700	5,100

[1] Estimated from Census of Agriculture.

[1] Additional details on the subject of land use in agriculture may be found in Land Usage and Development Appendix—Agriculture, Puget Sound and Adjacent Waters Comprehensive Water Resource Study.

[2] Farms are classified in the Census of Agriculture according to the major source of income from farm product sales, e.g., a poultry farm is one for which 50% or more of the farm income comes from the sale of poultry. Classification of farms include the following types: field crop, vegetables, fruit and nut, poultry, dairy, and livestock. Farms are classsified as general and miscellaneous if income is derived from sources other than those listed or if sales fall within three or more categories with no one source providing a majority.

TABLE 7. Rural farm population, PS&AW 1963, with projections to 1980, 2000 and 2020

Division	Rural Farm Population			
	1963[1]	1980	2000	2020
	Number	Number	Number	Number
North	16,150	10,050	8,325	6,980
Central	17,850	8,900	5,800	3,980
West	7,000	4,850	3,700	2,740
PS&AW	41,000	23,800	17,825	13,700

[1] Estimated from Census of Population.

Rural Farm Population

Between 1950 and 1960, the rural farm population in the Puget Sound Area declined 56%. This change is related to the reduction in number of farms, the one factor which has had the largest single influence on changes in rural farm population in the Area. Other factors which affect the size of the rural farm population include: (1) the size of farm households (persons per household), (2) the proportion of farms which serve as a place of residence, and (3) the proportion of farms which are located in areas classified as "rural" in the Census of Population.

The projections of rural farm population (in Table 7) have given the greatest weight to changes in number of farms as determining future population levels; thus, population is projected to decline substantially. The potential for change in the size of farm households is assumed to be limited since the farm family is now, at 3.63 persons per household, nearly the same size as all other families and is not changing rapidly. The proportion of farms which serve as a place of residence, approximately 96%, is a factor which displays a high degree of stability. However, the final factor, whether or not the farm is determined to lie within a rural area, can be subject to substantial change. The projections of rural farm population for the Area and for the three economic divisions in Table 7 are based upon the assumption that there will be little change in this factor. For the North and West Divisions, this assumption is quite a reasonable one, but it is possible that nearly all of the census divisions of the Central Division which contain farms will be classed as "urban" prior to 2020.[1] Therefore, an alternative projection might be developed which would essentially eliminate most or all of the rural farm population from the Central Division.

Farm Employment

Between 1950 and 1960, the number of employees on farms in the Puget Sound Area dropped nearly one-third.[2] Increased use of capital and the adoption of larger scales of operation have increased the average productivity of labor. Further, the increased use of other purchased factors, e.g., fertilizer and pesticides, has boosted the output per worker.

While farm employment has declined, the reduction has not matched the decline in the number of farms. The number of employees per farm enterprise increased somewhat over the last 10 years. Nevertheless, changes in total farm employment have been more closely related to the changes in farm numbers than any other single factor. At least three elements can be identified, however, which have some effect in changing the ratio of employees per farm; these are: (1) the scale of operation, measured as output per farm, (2) labor productivity, and (3) the proportion of all farms which are commercial operations. While increasing labor productivity tends to decrease the ratio of employees per farm, the effects of increasing scale of operation and of increasing proportion of commercial farms have dominated in the recent past; thus, the ratio of employees per farm has risen slightly.

[1] According to the 1960 Census of Population, urban is defined as including: (1) Urban places—incorporated and unincorporated places of 2,500 inhabitants or more, and (2) Urbanized areas— an urban complex containing at least one city of 50,000 inhabitants or more and the surrounding closely settled area that meets one of the following criteria:

(a) Incorporated places with a population of 2,500 or more.

(b) Incorporated places with a population of less than 2,500, providing there exists a closely settled area with at least 100 housing units.

(c) Enumeration districts in unincorporated territory with a population density of at least 1,000 persons per square mile.

(d) Other enumeration districts which are included to eliminate small nonurban enclaves within a contiguous area which is classed as urbanized.

[2] Census of Population: Census of Agriculture.

The projections of farm employment shown in Table 8 reflect an expected continuation of past trends with some modifications. The largest component of change in farm employment will continue to be the decline in number of farms. An additional factor leading to decreased farm employment will be the continued increase in labor productivity. Counter forces to a decline in employment will be provided by increased scale of farm operation and increased proportion of commercial farms, but the influence of the latter will substantially disappear before the end of the projection period. Thus, it is projected for 2000 and 2020 that the ratio of employees per farm will stabilize at around 1.55.

TABLE 8. Employment in agriculture PS&AW with projection to 1980, 2000 and 2020

	Employment in Agriculture			
Division	1963[1]	1980	2000	2020
	Number	Number	Number	Number
North				
Family	4,800	3,000	2,400	2,050
Hired	1,600	2,100	2,000	1,750
Total	6,400	5,100	4,400	3,800
Central				
Family	6,100	3,400	2,200	1,500
Hired	5,400	4,500	2,400	1,300
Total	11,500	7,900	4,600	2,800
West				
Family	2,000	1,440	1,100	850
Hired	300	560	400	350
Total	2,300	2,000	1,500	1,200
PS&AW				
Family	12,900	7,840	5,700	4,400
Hired	7,300	6,060	4,800	3,400
Total	20,200	15,000	10,500	7,800

[1] *Estimated from Census of Population and Labor Force and Employment in Washington State.*

Production and Value of Production

Crops Significant changes have taken place in the quantity and composition of crop production. Between 1959 and 1964 the following changes occurred in the Puget Sound Area: (1) the production of hay declined 7%, (2) the production of small grains dropped 68%, (3) the production of vegetables increased 40%, (4) the production of berries increased 3%, and (5) the production of tree fruits and nuts dropped 60%.[1] The 1963 levels[2] of crop production, with additional information on acreage, yield, and value are shown in Table 9.

Future developments in farm crop production are dependent upon changes in the availability of land, the markets for regional output, and the techniques adopted in crop production. The amount of land available for crop production provides one restriction limiting potential supply. The level of production technology adopted by regional producers is the other major factor which, given the quantity of cropland, determines the upper physical limit to regional crop production. The economic limits to regional crop output are determined by the market demand for the regional product. An analysis of "concentration coefficients" for major crops has revealed that only vegetables and berries for processing are produced for markets outside the Puget Sound Area and that production of all other crops is insufficient to meet local demands.[3]

The method for projecting farm crop production utilized information gathered about land availability, crop yields, markets, etc. Important factors in formulating these projections shown in Table 10 include the following: (1) the total amount of cropland acreage was projected for future time periods, (2) the production of vegetables and berries was projected to be consistent with the growth in market demand;[4,5] (3) the changes in yields for vegetables, berries, and other crops were projected to

[1] Estimated from the Census of Agriculture.

[2] The date shown is for a 1962 to 1964 average, adopted to normalize yearly observations to eliminate fluctuations due to weather.

[3] See Isard, Walter, Methods of Regional Analysis: An Introduction to Regional Science, Technology Press, 1960, pp. 249-54.

4 U.S. Department of Agriculture, Economic Research Service, Agricultural Production and Food Processing in the Pacific Northwest, 1960-1985 Administrative report to BPA, Department of the Interior, Corvallis, Oregon, July 1964.

5 Preliminary unpublished projections have been developed by the U.S. Department of Commerce and Agriculture under the auspices of a program "Economic and Statistical Analysis and Projections for Comprehensive River Basin Planning" sponsored by the Water Resources Council.

TABLE 9. Production, acreage, yield and value of production of major crop group for PS&AW, 1963[1].

Crop Group	Production	Acreage	Yield	Value of Production
	Tons	Acres	Tons/Acre	$1,000
Small grains				
PS&AW	17,490.00	16,500.00	1.06	811.70
State	3,001,144.00	2,781,000.00	1.08	168,505.00
Percent	0.58	0.59		0.48
Field crops				
PS&AW	35,060.00	3,280.00	10.69	978.80
State	2,324,750.00	377,000.00	6.17	75,190.00
Percent	1.51	0.87		1.30
Hay				
PS&AW	301,000.00	145,000.00	2.12	6,498.60
State	1,976,000.00	854,000.00	2.31	45,855.00
Percent	15.23	16.98		14.17
Silage				
PS&AW	373,000.00	42,000.00	8.88	2,706.00
State	1,065,700.00	93,400.00	11.41	8,090.10
Percent	35.00	44.97		33.45
Vegetables				
PS&AW	170,500.00	45,635.00	3.74	10,698.70
State	486,600.00	137,640.00	3.54	30,559.00
Percent	38.00	33.16		35.01
Fruits and Nuts				
PS&AW	2,000.00	2,000.00	1.00	234.30
State	1,058,800.00	132,350.00	8.00	89,332.00
Percent	0.19	1.51		0.26
Berries				
PS&AW	29,734.50	8,760.00	3.39	8,399.50
State	43,734.00	13,840.00	3.16	11,309.00
Percent	67.99	63.29		74.27

[1] Estimated from Statistical Reporting Service and Census Agriculture.

be consistent with work done by Poli[1] and others;[2] (4) the acreage of vegetables and berries was derived and the residual acreage in all other crops determined; (5) the acreage of residual cropland was allocated among other major crops according to recent trends; and (6) the production of the remaining major crops was derived from allocated acreages and yield projections.

[1] Poli, Adon, "Long-term Production Prospects for Western Agriculture," U.S.D.A., Agricultureal Economics Report No. 33, FPED-ERS, May 1963.

[2] USDA, ERS, Agricultural Production and Food Processing in the Pacific Northwest, 1960-1985, op. cit.

TABLE 10. Production by major crop groups, PS&AW 1963 with projections to 1980, 2000 and 2020.

Crop Group	1963[1]	1980	2000	2020
	Production			
	Tons	Tons	Tons	Tons
Small grains[2]	17,490	1,490	900	-
Field crops[3]	35,060	30,000	26,000	26,000
Hay[4]	301,000	255,600	158,000	55,000
Silage[5]	373,000	238,000	145,000	64,000
Vegetables[6]	170,500	307,300	440,000	603,000
Fruits and nuts[7]	2,000	650	-	-
Berries[8]	29,735	45,100	61,000	77,000

1 Estimated from Census of Agriculture and Statistical Reporting Service. U.S.D.A.

2 Small grains include: wheat, barley, oats, rye and corn.

3 Field crops include: potatoes, hops, mint, lentils, dry field peas and beans, and alfalfa seed.

4 Hay includes: alfalfa, clover-timothy, grain, other tame, and wild hay.

5 Silage includes: corn and grass.

6 Vegetables include: asparagus, lima beans, snap beans, broccoli, cabbage, cantaloupe, carrots, cauliflower, celery, sweet corn, cucumbers, lettuce, onions, green peas, rhubarb, spinach, turnip, and tomatoes.

7 Fruits and nuts include: apples, peaches, pears, cherries, apricots, plums, grapes, and filberts.

8 Berries include: blueberries, blackberries, currents, red respberries, black raspberries,strawberries, cranberries and loganberries.

Substantial changes in crop production are projected for the region. Production of vegetables and berries is expected to increase by an estimated 250% and 160%, respectively, by 2020. The production of hay and silage is expected to decline by an estimated 80% and the production of field crops is expected to decrease by an estimated 25% over the same time period. The production of all other crops will become an insignificant factor in the regional economy.

The projections of crop production are converted to value of output projections (Table 11) based upon a set of current normalized prices for agricultural products.[1,2] It is assumed that relative prices of all products will remain substantially stable over time; thus, current prices provide the best basis for intertemporal comparisons of value.

Livestock and Livestock Products—Three major products dominate and sustain the livestock sector of the Puget Sound Area; these are milk, eggs, and broilers. All other livestock products have declined in importance over the last 10 years. Analysis using "concentration coefficients" has indicated that the output of the three major livestock products shown in Table 12 has been geared to the needs of the local market; exports have not been a factor of great importance.

The one potential restriction on the supply of the major dairy and poultry products is the inability of the Area to provide the feed and forage required for production. However, most of the feed grains and an increasing share of forage are being profitably imported into the Area. Moreover, a substantial

1 From unpublished data prepared by Economic Research Service, U.S. Department of Agriculture.

2 Water Resources Council, Interdepartmental Staff Committee, Interim Price Standards for Planning and Evaluating Water and Land Resources, Washington, D. C. April 1966.

TABLE 11. Value of production by major crop groups PS&AW 1963 with projections to 1980, 2000, and 2020

Crop Group	1963[1]	1980	2000	2020
	Value of Production			
	$1,000	$1,000	$1,000	$1,000
Small grains	811.7	69.0	42.0	-
Field crops	978.8	838.0	726.0	726.0
Hay	6,498.6	5,518.0	3,411.0	1,188.0
Silage	2,706.0	1,726.0	1,051.0	464.0
Vegetables	10,698.7	19,283.0	27,610.0	37,838.0
Fruits and Nuts	234.3	76.0	-	-
Berries	8,399.5	12,740.0	17,231.0	21,751.0
All crops	30,327.6	40,250.0	50,071.0	61,967.0

1 Estimated from Census of Agriculture and Statistical Reporting Service, U.S.D.A.

TABLE 12. Production and value of production by livestock and livestock product group for PS&AW, 1963[1]

Major Commodity	Number	Unit of Measurement	Quantity Produced	Value of Production
	Thousands	Million	Millions	Thousand Dollars
CATTLE AND CALVES				
PS&AW	320.00	lbs.lv.wt.	82.20	16,226.00
State	1,360.00	lbs.lv.wt.	394.00	77,776.00
Percent	23.50		20.86	20.86
HOGS AND PIGS				
PS&AW	15.60	lbs.lv.wt.	5.13	846.00
State	120.00	lbs.lv.wt.	39.43	6,506.00
Percent	13.00		13.00	13.00
SHEEP AND LAMBS				
PS&AW	15.00	lbs.lv.wt.	1.07	171.00
State	230.00	lbs.lv.wt.	16.44	2,630.00
Percent	6.52		6.52	6.52
CHICKENS				
PS&AW	3,300.00	lbs.lv.wt.	8.55	598.00
State	5,300.00	lbs.lv.wt.	13.90	973.00
Percent	61.50		61.50	61.50
TURKEYS				
PS&AW	106.80	lbs.lv.wt.	2.09	439.00
State	445.00	lbs.lv.wt.	8.69	1,825.00
Percent	24.00		24.00	24.00
BROILERS				
PS&AW	11,965.00	lbs.lv.wt.	43.86	7,456.00
State	17,607.00	lbs.lv.wt.	64.54	10,972.00
Percent	67.96		67.96	67.96
MILK				
PS&AW		lbs.	1,228.00	53,084.00
State		lbs.	1,920.00	82,944.00
Percent			64.00	64.00
EGGS				
PS&AW		Number	650.38	18,405.75
State		Number	1,049.00	29,686.70
Percent			62.00	62.00
WOOL				
PS&AW		lbs.	.09	43.74
State		lbs.	1.90	810.00
Percent			5.40	5.40

[1] Source: Statistical Reporting Service and Census of Agriculture.

TABLE 13. Value of production of livestock and livestock products P[illegible]W with projections to 1980, 2000, 2020

Major Commodity	Value of Production 1963[1]	1980	2000	2020
	$1,000	$1,000	$1,000	$1,000
Cattle and calves	16,226.0	19,254.0	23,488.0	28,673.0
Hogs and pigs	846.0	412.0	412.0	412.0
Sheep and lambs	171.0	72.0	72.0	72.0
Chickens	598.0	699.0	853.0	1,049.0
Turkeys	439.0	189.0	189.0	189.0
Broilers	7,456.0	10,982.0	14,807.0	18,020.0
Milk	53,084.0	67,223.0	88,794.0	116,721.0
Eggs	18,405.8	25,767.0	34,707.0	46,695.0
Wool	43.7	31.0	31.0	31.0
All livestock and livestock prod.	97,309.5	124,629.0	163.353.0	211.862.0

[1] Estimated from Census of Agriculture and Statistical Reporting Service.

acreage of pastureland is projected to remain available for use in the future.

The value of output of livestock and livestock products is projected as shown in Table 13. The prices used represent current normalized prices, assumed to remain relatively stable over the projection period. The value of broiler production is projected to increase from $7.5 million in 1963 to $18 million by 2020. The value of egg production in the Puget Sound Area is expected to rise from $18.4 million to $46.7 million over the same period. Milk production will dominate the entire agricultural sector, however, as value of output is projected to increase from $53 million in 1963 to $116.7 million by 2020.

Input-Output Data

Part of this study was devoted to the development of the input-output data (shown in Tables 10-13). The sectoring pattern for agriculture was modeled after the recently completed study of interindustry sales in the State of Washington.[1]

The four agricultural sectors produced a gross output of nearly $136 million in 1963. Of this amount, 40%, or $54 million represents the value added by employing the human, natural and capital resources of the Area in agricultural activities. In addition, $65 million of the gross agricultural output represents purchases from other industries within the Puget Sound Area; $16 million represents the imports needed for production by regional agriculture. Over $100 million, or nearly 74%, of the agricultural output was purchased by other industries within the Area for additional processing. Most of the remaining production, $32 million, or 24%, was purchased by consumers within the region. About 2% of regional farm output was exported by the agricultural sectors.

The projection of total 1980 flows in agriculture was derived from the projections of production, described above. Future levels of factor productivity are related to changes in crop yields, feeding efficiencies, size of operating units, and labor productivity. An indication of the change in factor productivity is that purchases from other industry in the Area are assumed to increase 21%, from $65.3 million to $79.1 million, while total output is assumed to increase 33%. Imports are assumed to increase approximately 32% over the same period. The relative increase in imports over Puget Sound purchases can be attributed to increased imports of forage inputs by the livestock sector and does not represent widespred import substitution. Another measure of gains in productivity may be found in comparing the percentages of output attributed to value added for the two periods. In 1963, 40% of output was returned to capital, labor, and land; by comparison, value added is projected to reach 44% by 1980. The real significance is somewhat greater than this difference may indicate since physical inputs of both land and labor are projected to decline during the period.

[1] Bourque, Philip J., et al, "The Washington Inter-industry Study for 1963," University of Washington Business Review, Vol. XXV, No. 3, February 1966.

TABLE 14. Interindustry purchases by agriculture, Puget Sound and Adjacent Waters Area, 1963

	Purchasing Industry							
	Field Crops		Vegetables		Livestock & Products		Other Agriculture	
Supplying Industry	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.
	$1000		$1000		$1000		$1000	
Field crops	127.6	.0395	23.2	.0012	1,474.7	.0151		
Vegetables			421.3	.0218				
Livestock & products					4,131.2	.0423		
Other agriculture			417.5	.0216			673.9	.0439
Fishing								
Meat products								
Dairy products								
Canning & preserving								
Grain mills					30,275.5	.3100		
Beverages								
Other foods								
Textiles			65.7	.0034			16.9	.0011
Apparel								
Mining								
Forestry								
Logging								
Sawmills	2.6	.0008	27.1	.0014	966.9	.0099	21.5	.0014
Plywood								
Other wood			0.8	*				
Furniture & fixtures								
Pulpmills								
Paper mills			11.6	.0006				
Paperboard mills							1,301.7	.0848
Printing & publishing			3.9	.0002				
Industrial chemicals								
Other chemicals	37.8	.0117	212.5	.0110	361.4	.0037	56.8	.0037
Petroleum refining	235.2	.0728	711.2	.0368	1,425.9	.0146	592.5	.0386
Glass & stone							52.2	.0034
Cement & clay prod.								
Iron & steel								
Nonferrous metals								
Aluminum								
Heavy metal prod.								
Light metal prod.	47.2	.0146	11.6	.0006	205.1	.0021		
Nonelec. motive equip.								
Machine tools & shops	135.4	.0419	614.6	.0318	1,250.1	.0128	15.4	.0010
Nonelec. indus. equip.								
Elec. machinery								
Aerospace								
Motor vehicles								
Shipbuilding								
Other manufacturing								
Transportation serv.	10.4	.0032	44.5	.0023	1,074.3	.0110	84.4	.0055
Electric utilities	30.0	.0093	32.9	.0017	1,220.8	.0125	207.2	.0135
Gas companies								
Water services								
Communications	11.6	.0036	32.9	.0017	400.4	.0041	113.6	.0074
Construction	91.4	.0283	71.5	.0037	1,054.8	.0108	135.1	.0088
Trade services	14.2	.0084	44.5	.0063	1,425.9	.0184	112.1	.0087
Finance	193.3	.0598	662.9	.0343	8,037.6	.0823	500.4	.0326
Insurance	125.0	.0387	400.0	.0207	947.3	.0097	300.0	.0215
Real estate								
Business services			0.3	*			319.3	.0208
Personal services					1,396.6	.0143	225.6	.0147
PS&AW Purchases	1,061.7	.3326	3,810.5	.2011	55,648.5	.5736	4,758.6	.3114
Import	434.9	.1306	2,546.1	.1277	12,500.9	.1242	716.8	.0453
Value added	1,734.5	.5368	12,975.9	.6712	29,513.8	.3022	9,874.6	.6433
Capital consumption	386.4	.1196	1,997.0	.0133	5,986.7	.0613	474.3	.0339
Labor & land	1,348.1	.4172	10,978.9	.5679	23,527.1	.2409	9,400.3	.6094
Gross output	3,231.1	1.0000	19,332.5	1.0000	97,663.2	1.0000	15,350.9	1.0000

* Less than .00005.

TABLE 15. Interindustry sales by agriculture, Puget Sound and Adjacent Waters Area, 1963

	Supplying Industry							
	Field Crops		Vegetables		Livestock & Products		Other Agriculture	
Supplying Industry	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.
	$1000		$1000		$1000		$1000	
Field crops	127.6	.0395						
Vegetables	23.2	.0072	421.3	.0218			417.5	.0272
Livestock & products	1,474.7	.4564			4,131.2	.0423		
Other agriculture							673.9	.0439
Fishing								
Meat products					23,214.5	.2377		
Dairy products					50,384.4	.5159		
Canning & preserving			15,798.6	.8172			999.3	.0651
Grain mills	800.0	.2476						
Beverages								
Other foods								
Textiles							307.0	.0200
Apparel								
Mining								
Forestry								
Logging							1,399.9	.0912
Sawmills								
Plywood								
Other wood								
Furniture & fixtures								
Pulpmills								
Paper mills								
Paperboard mills								
Printing & publishing								
Industrial chemicals								
Other chemicals								
Petroleum refining								
Glass & stone								
Cement & clay prod.								
Iron & steel								
Nonferrous metals								
Aluminum								
Heavy metal prod.								
Light metal prod.								
Nonelec. motive equip.								
Machine tools & shops								
Nonelec. indus. equip.								
Elec. machinery								
Aerospace								
Motor vehicles								
Shipbuilding								
Other manufacturing								
Transportation serv.								
Elec. utilities								
Gas companies								
Water services								
Communications								
Construction								
Trade services								
Finance								
Insurance								
Real estate								
Business services								
Personal services								
PS&AW Interindustry Sales	2,425.5	.7507	16,219.9	.8390	77,730.1	.7959	3,797.6	.2474
PS&AW personal consumption	48.5	0150	2,934.7	.1518	19,503.3	.1997	9,587.6	.6246
Export	757.1	.2343	177.9	.0092	429.8	.0044	1,964.8	.1280
Gross output	3,231.1	1.0000	19,332.5	1.0000	97,663.2	1.0000	15,350.0	1.0000

TABLE 16. Interindustry purchases by agriculture, Puget Sound and Adjacent Waters Area, 1980

	Purchasing Industry							
	Field Crops		Vegetables		Livestock & Products		Other Agriculture	
Supplying Industry	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.
	$1000		$1000		$1000		$1000	
Field crops	62.0	.0300	32.1	.0010	1,161.0	.0093		
Vegetables			558.5	.0174				
Livestock & products					5,018.8	.0402		
Other agriculture			555.3	.0173			896.6	.0417
Fishing								
Meat products								
Dairy products								
Canning & preserving								
Grain mills					36,766.9	.2945		
Beverages								
Other foods								
Textiles			86.7	.0027			23.6	.0011
Apparel								
Mining								
Forestry								
Logging								
Sawmills	1.7	.0008	35.3	.0011	861.4	.0069	30.1	.0014
Plywood								
Other wood			+	*				
Furniture & fixtures								
Pulpmills								
Paper mills			19.3	.0006				
Paperboard mills							1,823.2	.0848
Printing & publishing			6.4	.0002				
Industrial chemicals								
Other chemicals	22.9	.0111	337.0	.0105	387.0	.0031	75.2	.0035
Petroleum refining	143.0	.0692	1,123.5	.0350	1,460.7	.0117	789.1	.0367
Glass & stone							68.8	.0032
Cement & clay prod.								
Iron & steel								
Nonferrous metals								
Aluminum								
Heavy metal prod.								
Light metal prod.	28.7	.0139	19.3	.0006	212.2	.0017		
Nonelec. motive equip.								
Machine tools & shops	82.3	.0398	969.4	.0302	1,273.4	.0102	21.5	.0010
Nonelec. indus. equip.								
Elec. machinery								
Aerospace								
Motor vehicles								
Shipbuilding								
Other manufacturing								
Transportation serv.	6.2	.0030	70.6	.0022	1,310.9	.0105	111.8	.0052
Elec. utilities	14.7	.0071	44.9	.0014	1,473.2	.0118	275.2	.0128
Gas companies								
Water services								
Communications	5.6	.0027	44.9	.0014	412.0	.0033	150.5	.0070
Construction	58.5	.0283	112.4	.0035	1,285.9	.0103	180.6	.0084
Trade services	16.5	.0080	192.6	.0060	2,234.7	.0179	176.3	.0082
Finance	117.4	.0568	1,046.4	.0326	9,762.9	.9782	666.5	.0310
Insurance	76.1	.0368	632.4	.0197	1,148.6	.0092	438.6	.0204
Real estate								
Business services							43.0	.0020
Personal services					1,785.3	.0143	301.0	.0140
PS&AW Purchases	635.6	.3075	5,887.0	.1834	66,554.9	.5331	6,071.6	.2824
Import	256.5	.1241	3,893.6	.1213	16,229.8	.1300	926.7	.0431
Value added	1,174.9	.5684	22,318.4	.6933	42,060.3	.3369	14,501.7	.6745
Capital consumption	234.8	.1136	3,148.9	.0981	7,266.0	.0582	696.6	.0324
Labor & land	940.1	.4548	19,169.5	.5972	34,794.3	.2787	3,805.1	.6421
Gross output	2,067.0	1.0000	32,099.0	1.0000	124,845.0	1.0000	21,500.0	1.0000

\+ Less than $100.

* Less than .00005.

TABLE 17. Interindustry sales by agriculture, Puget Sound and Adjacent Waters Area, 1980

	Supplying Industry							
	Field Crops		Vegetables		Livestock & Products		Other Agriculture	
Supplying Industry	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.	Amount	Coeff.
	$1000		$1000		$1000		$1000	
Field crops	62.0	.0300						
Vegetables	32.1	.0155	558.5	.0174			555.3	.0258
Livestock & products	1,161.0	.5617			5,018.8	.0402		
Other agriculture							896.6	.0417
Fishing								
Meat products					30,362.3	.2432		
Dairy products					64,095.4	.5134		
Canning & preserving			26,350.1	.8209			1,249.2	.0581
Grain mills	56.6	.0274						
Beverages								
Other foods								
Textiles							430.0	.0200
Apparel								
Mining								
Forestry								
Logging								
Sawmills							750.3	.0349
Plywood								
Other wood								
Furniture & fixtures								
Pulpmills								
Paper mills								
Paperboard mills								
Printing & publishing								
Industrial chemicals								
Other chemicals								
Petroleum refining								
Glass & stone								
Cement & clay prod.								
Iron & steel								
Nonferrous metals								
Aluminum								
Heavy metal prod.								
Light metal prod.								
Nonelec. motive equip.								
Machine tools & shops								
Nonelec. indus. equip.								
Elec. machinery								
Aerospace								
Motor vehicles								
Shipbuilding								
Other manufacturing								
Transportation serv.								
Elec. utilities								
Gas companies								
Water services								
Communications								
Construction								
Trade services								
Finance								
Insurance								
Real estate								
Business services								
Personal services								
PS&AW Interindustry Sales	1,311.7	.6346	26,908.6	.8383	99,476.5	.7968	3,881.4	.1805
PS&AW personal consumption	31.0	.0150	4,895.1	.1525	24,706.8	.1979	14,623.7	.6802
Export	724.3	.3504	295.3	.0092	661.7	.0053	2,994.9	.1393
Gross output	2,067.0	1.0000	32,099.0	1.0000	124,845.0	1.0000	21,500.0	1.0000

Exhibit B
Prospective Timber Supplies and Forest Industrial Development

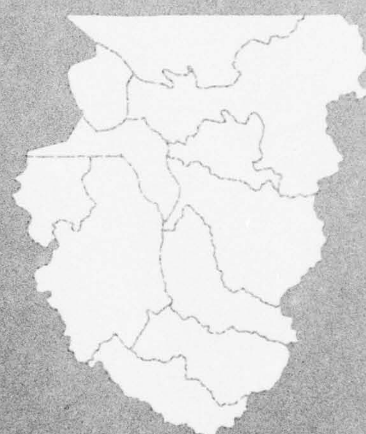

EXHIBIT B

PROSPECTIVE TIMBER SUPPLIES
AND
FOREST INDUSTRIAL DEVELOPMENT
IN THE
PUGET SOUND AND ADJACENT WATERS AREA

Prepared for

PUGET SOUND TASK FORCE of the PACIFIC NORTHWEST
RIVER BASINS COMMISSION

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U. S. DEPARTMENT OF AGRICULTURE

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PREFACE

In 1964, Congress authorized Federal participation in a comprehensive study of the water and related land resources of the area of northwest Washington, later designated as Puget Sound and Adjacent Waters. The Columbia Basin Interagency Committee delegated responsibility for the study to its newly-established subsidiary, the Puget Sound Task Force. Representatives for the State of Washington and several Federal departments comprise the Task Force. Within this organization, Economic Research Service serves as one of the Federal study participants. ERS has major responsibilities for the analysis and projection of the regional agricultural economy and related sectors and for the analysis of agricultural water problems and appraisal of needs for rural resource development.

The purpose of this report is two-fold: (1) to provide a useful reference for all interested study participants, and (2) to summarize available data related to the present and recent past activity of the agricultural sector of the Puget Sound Area. Information is included regarding agricultural use of land and water, employment in agriculture, rural population, and output and sales of agricultural products. The following report incorporates a general analysis of recent trends in the rural agricultural economy. Those interested in further analysis and in projections of future activity are referred to Exhibit D, by Consulting Services Corp.

SUMMARY

Forest products manufactured in the Puget Sound Area contribute significantly to the Nation's timber economy. Increasing national and world demand for wood assures that the Area's production will be limited only by the economically available supply of timber. The Area's forests will sustain a greater timber harvest. This, plus a continuing import of both residue and roundwood, will assure an increasing total raw material supply for forest industry consumption. The volume of sawtimber inventory will continue to decline as young trees replace old-growth timber, while during the same period there will be an increase in forest growth rates. Changing national demand will alter the forest product mix; the paper and allied products industry will become the dominant consumer of wood fiber in the Area by 2020. Depsite increasing wood consumption, forest employment will decline due to gains in labor productivity.

EXHIBIT B

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INTRODUCTION

The purpose of this report is to provide an analysis of the present and projected timber resources and forest industries in the Puget Sound Area for the use of the Forests Work Group of the Puget Sound Task Force. Results from this analysis will be incorporated into the interagency Puget Sound and Adjacent Waters Comprehensive Water Resources Study. This report was prepared by the Pacific Northwest Forest and Range Experiment Station under a memorandum of understanding between the U.S. Forest Service, Region 6 and the Station, dated January 17, 1966.

This study of timber supplies and forest industrial development is divided into five areas of subject matter. First, the forest resource as of the year 1963 is described. The basis for this is a special compilation and updating of 1951-63 Forest Survey timber inventories in the Puget Sound Area. Second, the present forest industry is examined. The third section presents the projection of the future timber economy in terms of wood consumption and employment. This section also reviews the national trends in the consumption of timber products and notes the assumptions underlying the national and basin projections. Changes in the characteristics of the future timber resource are described on a broad basis in the fourth section. In the concluding section, the appendix, data on the resources and industries are presented in tables.

The reports "Timber Trends in the United States," by the Forest Service, and "Prospective Economic Developments Based on the Timber Resources of the Pacific Northwest," (Gedney, et al. 1966), have been used as basic sources in this study. The factors which affect the forest economy such as markets and raw material supply have continued to change since these reports were completed. The trends in the Puget Sound Study have been modified to reflect these changes.

THE PRESENT TIMBER RESOURCE

The total land area of the Puget Sound Area is 8,435,000 acres or 53 percent of the 15,874,000 acres in western Washington (U.S. Forest Service 1965). A smaller proportion of western Washington's commercial forest land is located in the Area–45 percent or 5,004,000 acres (Table 4). The Area's commercial forest land supports a sawtimber inventory of 100.9 billion board feet (International ¼-inch rule). This is 4 percent of the Nation's total and 35 percent of the western Washington total of 291.4 billion board feet (Table 7).

The timber resources of the Puget Sound Area have been used extensively for a long period of time. Because timber was easily accessible from the Sound, the forests were heavily cutover in areas nearest the shoreline in the first half of this century. These low elevation lands are now stocked with young-growth forests. At the higher elevations, especially in the Cascade Range and to some extent in the Olympic Range, forests consist mainly of old growth.

The Area's forest lands are used intensively because of their proximity to the growing Everett-Seattle-Tacoma metropolitan area. Recreation, urban sprawl, taxation, increasing land values, highways, airports, and powerlines are gradually reducing the forestland base. The result is an acceleration of efforts to increase production on the remaining area.

The complex of young and old-growth forests is reflected in forest management practices in the Area. On the public lands the rate of harvest of old growth is increasing; on private lands the annual timber harvest has been declining pending adjustment to a young-growth timber economy. This increased rate of cut of old-growth forests and the buildup of young-growth forests have resulted in a steady increase in timber growth. Because of timber's increasing value and because the forest resource is limited, investments in silvicultural practices have become profitable. As a result, brush control, planting, seeding, thinning, and liberation sprayings are more and more common on both public and private lands.

FIGURE 1. Study Area and Economic Divisions

CENTRAL DIVISION CONTAINS MOST OF THE COMMERCIAL FOREST LAND

For the purpose of analysis, the Puget Sound Area has been broken down into the following divisions: north, central, and west (Figure 1).

The north division is made up of four counties–Island, San Juan, Skagit, and Whatcom. The commercial forest area of this division is 1,456,000 acres or 54 percent of the division's total land area (2,716,000 acres) and is 29 percent of the Puget Sound Area's commercial forest land (Table 4). Skagit and Whatcom Counties, the two larger and more important forested counties in the subregion, have 89 percent of the commercial forest area in the north subregion. The rugged and mountainous eastern portions of these two counties has recently been converted to National Park and National Recreation Area status under the provisions of Public Law 90-544. This change is incorporated into this report.

Island and San Juan Counties, which together have less than 3 percent of the total commercial forest-land in the Area, are under increasing pressure for recreation use. It is likely that in a relatively short time their forest lands will be even less significant in the forest products economy of the Area.

Puget Sound's central division has the largest total land area–4,122,000 acres. It also has the most commercial forest land–2,635,000 acres–or 53 percent of the commercial forest land in the Puget Sound Area. (Table 4).

All of King, Kitsap, Pierce, and Snohomish Counties lie within the boundaries of the central division along with part of Lewis County. King, Pierce, and Snohomish Counties account for 88 percent of the commercial forest land in this division and 46 percent of the commercial forest land in the Puget Sound Area. These same three counties are experiencing the greatest growth in population in the Area, with consequent increasing pressure for land use other than timber production.

The west division has both the smallest total land area (1,597,000 acres) and the least commercial forest land (913,000 acres). The commercial forest land represents 18 percent of the Puget Sound Area total. Parts of five counties lie within this division–Clallam, Jefferson, Mason, Thurston, and a very small area of Grays Harbor County. Mason County has the largest share (37 percent) of the commercial forest land in the division.

A large amount of the west division's commercial area consists of dry, relatively flat forest land along the shores of Puget Sound and Hood Canal. Here Christmas tree culture is practiced, and Shelton is known as the "Christmas Tree Capital of the World." The remaining commercial forest area presents a more varied forest condition in terms of both topography and timber species; it extends from the shores of Hood Canal over the foothills of the Olympic Mountains to the Olympic National Park. Old-growth timber stands and young-growth stands occur side by side on these hills with the older timber generally owned by public agencies.

Recreationists are attracted to this area because of its unique scenic quality and because it affords the opportunity to take part in popular activities such as boating, hiking, mountain climbing, swimming, fishing, and camping. Commercial forest lands are thus being used more and more for recreational purposes and the management of significant portions of these lands is frequently aimed more at developing this type of use rather than timber production.

OF COMMERCIAL FOREST LAND 56 PERCENT IS PRIVATELY OWNED

Private owners of commercial forest land hold 2,871,000 acres or 57 percent of the total. In general, these private lands tend to be located at lower elevations and near Puget Sound. Public agencies hold 2,133,000 acres (43 percent) of commercial forest land (Table 5). National Forests are the dominant public owners of forest lands with 1,294,000 acres or 61 percent of the public total. The National Forest commercial forest lands are located at the higher elevations in the Olympic and Cascade Mountain Ranges. A large share of the other public commercial forest land is owned by the State of Washington, and this ownership is in scattered blocks throughout the study area, usually at lower elevations.

In the north division the public and the private acreages of commercial forest land are near equal–705,000 acres (48 percent) and 751,000 acres (52 percent), respectively. The National Forests manage 58 percent of the public land in this part of the Puget Sound Area.

In the central and west divisions, 60% and 59% respectively, of the commercial forest land is privately owned. The private owners in the central division own 1,578,000 acres of commercial forest land, and in the west 542,000 acres. Public ownership

of commercial forest land is greatest in the central division (1,057,000 acres) and least in the west division (371,000 acres). In the latter division, National Forests hold the majority of the commercial area (Table 5)

OF COMMERCIAL FOREST LAND 55 PERCENT IS IN SAWTIMBER STANDS

Sawtimber stands form a combined area of 2,730,000 acres or 55 percent of the commercial forest land. Poletimber stands occupy the second largest area (1,578,000 acres or 31 percent), whereas sapling and seedling stands rank third (626,000 acres or 13 percent). About 1 percent of the commercial forest area is nonstocked (Table 6).

The distribution of sawtimber, poletimber, and seedling and sapling stands among the divisions reflects differences in past cutting practices, site, reforestation objectives, and land use objectives. The north and central divisions indicate a broad similarity in stand conditions because of their similar histories. Here, sawtimber stands occupy about 60 percent of the forest area, and poletimber accounts for about 30 percent with the remainder mostly in seedling and sapling stands. The west division has a somewhat different pattern of stand-size classes due to an earlier logging history on private lands, little reforestation, lower sites, and the holding of commercial forest land for uses other than forest production. Most of the commercial forest area is in the poletimber size class (42 percent) followed by sawtimber (37 percent). This division has the highest proportion of its land in saplings and seedlings in the Area (19 percent). Nearly two-thirds of the seedling and sapling stands in the west division are in Mason County.

SOFTWOOD SAWTIMBER VOLUME GREATEST IN THE CENTRAL DIVISION

The Puget Sound Area has 101 billion board feet of sawtimber (International ¼-inch rule), and a large part of this volume is concentrated in the foothills and at the higher elevations of the Cascade Range. The central division has 57 percent of the sawtimber volume the north, 29 percent; and the west, 14 percent (Table 7).

Douglas-fir accounts for the largest share of the softwood sawtimber volume in the Puget Sound Area—35 percent. The proportion of western hemlock volume is nearly as great (32 percent), followed by the true firs (26 percent). Other softwoods such as white pine, lodgepole pine, and western red cedar account for 7 percent of the Area's softwood sawtimber volume (Table 8).

Within the Puget Sound Area, the softwood timber species mix varies by division. For example, in the north division the true firs with 40 percent of the softwood sawtimber volume and western hemlock with 32 percent are the two principal species. Here, douglas-fir ranks third with 21 percent of the volume.

Douglas-fir is the leading softwood species in the central division with 35 percent of the softwood sawtimber volume, whereas western hemlock has 34 percent. In the west division with its drier sites and gravelly soils, douglas-fir is the dominant sawtimber species with 66 percent of the softwood sawtimber volume.

OF SAWTIMBER VOLUME, 5 PERCENT IS HARDWOOD

The hardwood sawtimber volume in the Puget Sound Area is 4.7 billion board feet or nearly 5 percent of the Area's total sawtimber volume. Red alder is the major hardwood species in the Area accounting for 64 percent of the hardwood sawtimber volume. Other hardwood species typical of the Puget Sound Area include big leaf maple, black cottonwood, and madrona. Hardwood species often temporarily invade the better conifer sites following logging or fire. Hardwood types took over a large amount of forest land following logging of softwood timber in the first half of this century. The forest land of the central division supports the largest hardwood inventory in the Area (2.6 billion board feet), followed by the north division (1.5 billion board feet). The west has a hardwood sawtimber inventory of 591 million board feet (Table 8).

MOST OF SAWTIMBER VOLUME IN NATIONAL FORESTS

Differences in the way forest lands have been managed in the past are reflected in the sawtimber inventory. Because of early liquidation of the old growth on the private and other public lands, sawtimber volumes per acre on these lands are much lower on the average than those on National Forest lands. Thus, private forests, which account for over

half the land in the Area, support only about a third of the sawtimber inventory—34.9 billion board feet. National Forests have most, 51 percent, of the Area's sawtimber inventory (51.6 billion board feet) on slightly more than one-quarter of the forest area. Other public agencie have 14 percent of the sawtimber (14.4 billion board feet) on 17 percent of the commercial forest land.

The distribution of sawtimber volume among owners in the north and central divisions approximates the Area average. Because the west division has a higher percentage of other public and private land and its National Forests have a large amount of old growth, the sawtimber volume distribution is more varied. Here the National Forests hold 63 percent of the commercial sawtimber inventory on one-quarter of the commercial forest land. Private owners have 31 percent of the inventory on over half the land, whereas other public agencies have 6 percent of the sawtimber on 15 percent of the commercial forest area.

THE PRESENT FOREST INDUSTRY

The present forest industry of the Puget Sound Area is described in this section of the report in terms of log production, timber products output, and employment. A special compilation of log production data was made for the Area.

Timber products output data were derived from such sources as the Bureau of the Census and industrial associations. Employment information is based on data supplied by Washington State's Employment Security Department. In preparing the industrial statistics, care was taken to include only those county data which pertained to the Puget Sound Area.

PUGET SOUND'S LOG PRODUCTION ESSENTIALLY LEVEL 1950-63

In 1925 Washington was the Nation's leading State in log and lumber production, and most of this production came from western Washington (7.2 billion board feet, International ¼-inch Rule). About one-half of western Washington's timber harvest came from the Puget Sound Area in 1925. Logs from the Puget Sound Area were generally processed around Tacoma which claimed the title of "Lumber Capital of America" at that time (Tacoma Lumbermen's Club 1923).

Log production in western Washington has been through major changes since 1925. In 1929 production of timber west of the Cascade Range hit an all time peak of 8.2 billion board feet. During the depression, demand for timber declined and by 1932 log production had dropped to 2.5 billion board feet. During the period 1933-63, log production ranged between 3.6 and 5.6 billion board feet depending on fluctuations in business conditions. Western Washington's log production increased in recent years to 5.4 billion board feet in 1963, and in 1964 it reached is highest point since 1929—6.6 billion board feet.

The Area's log production has behaved, in general, like western Washington's although its share of the western total declined from about 51 percent in 1925 to 36 percent in 1950 and to 34 percent in 1963 (Table 10).

While total log production remained essentially level during the 1950-63 period, there were substantial shifts in the suppliers of logs. In 1950, the private owners supplied 80 percent of the total log harvest in the Puget Sound Area, whereas in 1963 they accounted for 54 percent. Production from private decreased 29 percent during this 14-year period, while production from all public lands increased 138 percent.

The National Forests had the greatest absolute increase in log production in the Puget Sound Area between 1950 and 1963—311 million board feet. This 110 percent increment in timber harvest reflected both the increasing demand for timber in the Area and the recalculation of allowable cut levels based on higher utilization standards and updated forest statistics. Other public had the greatest relative increase (251 percent), and a large part of this increment of 176 million board feet reflects the intensive management of State-owned lands by the Department of Natural Resources since the mid-1950's.

OUTPUT OF TIMBER PRODUCTS 1963

The manufacture of forest products in the Puget Sound Area remains important locally and

nationally. Since the 1920's the forest economy has diversified to become important in veneer and plywood production, pulp and paper production, and at the same time maintain a significant lumber industry.

The Puget Sound Area produced 1,257 million square feet (3/8 inch) of plywood in 1963. This represents 12 percent of the Nation's softwood plywood production and 67 percent of the State's production. The central division accounted for 61 percent of the plywood output in the Area, with most of this being manufactured in Pierce and Snohomish Counties (Table 11).

In 1963, mills in the Puget Sound Area produced 1,521,200 short tons of woodpulp. This represents 5 percent of the Nation's woodpulp production and 26 percent of production in the Western States, including Alaska and Hawaii. Pierce and Snohomish Counties, the only counties with pulpmills in the central division, produced 55 percent of the Area's woodpulp. The west division ranked second in production with 33 percent of total, followed by the north with 12 percent.

The production of lumber was still the major timber use in 1963. Four percent of the Nation's lumber output came from the Puget Sound Area—1,325 million board feet. The Area produced 37 percent of the lumber sawn in the State of Washington in 1963. Again the central division was the most important in terms of production; it produced 71 percent of the lumber with Snohomish and King Counties being the most important. The west division accounted for 21 percent of the lumber production and the north division had 8 percent.

The consumption of wood for miscellaneous wood products amounted to 75.1 million cubic feet. The central division accounted for 60 percent of this volume chiefly due to the export of timber, principally from the ports of Tacoma and Everett. The west division had an output of 24 percent, whereas the north's output came to 16 percent of the total.

EMPLOYMENT 1964

This section on forest industry employment is based on data provided by the Employment Security Department of the State of Washington. Forest employers have been divided into five major categories: paper and allied products (SIC 26), logging (SIC 2411), sawmills and planing mills (SIC 2421), veneer and plywood plants (SIC 2432), and miscellaneous lumber and wood products (SIC 24 except 2411, 2421, 2432).

The 59 paper and allied products plants employed 9,560 workers which was more than in any of the other major forest industry categories in the Puget Sound Area. Sawmills and planing mills and veneer and plywood plants employed about the same number of people in the Area—6,470 and 6,260, respectively. Miscellaneous lumber and wood products firms employed 4,310 workers and logging employment was estimated to be 3,200 workers. Employment of dock workers involved in the export of logs is not included in these data. Total forest industry employment in the Puget Sound Area was 29,800 workers in 1964 (Table 12).

The central division accounted for 67 percent (20,110 workers) of the forest industry's employment in the Puget Sound Area; the west division employed 21 percent (6,230 workers); and the north division had 12 percent (3,460 workers).

The paper and allied products industry generated 40 percent of the forest industry employment in the west division; this same industry also had the highest proportion of employment (30 percent) in both the north and central divisions in 1964. The west division had a high proportion of its employees in the veneer and plywood industry (31 percent) as did the north (20 percent) and the central (18 percent).

The north division's forest economy was the most resource oriented in the Area in terms of employment with 20 percent of its employees in logging activities, whereas the central and west divisions had 10 and 8 percent, respectively, so employed. Although sawmills and planing mills were a main source of forest industry employment in the past in the Area, they were not a principal employer in any one basin in 1964. However, in the central division they did account for 26 percent of the employment. This category of industry accounted for 15 percent of employment in the west division and 12 percent in the north (Table 1).

The Puget Sound Area depends heavily on the whole State's forest resource for its industry because it is an importer of raw material. In 1963, the consumption of roundwood in the Area amounted to 2.9 billion board feet, of which 1.1 billion board feet (38 percent) was imported into the Area, mostly from other parts of Washington, although a small amount came from Canada. Because of this, the future of the Puget Sound Area's forest economy and

employment rests in part on its ability to obtain wood from outside the Area.

CENTRAL DIVISION MOST IMPORTANT IN VALUE ADDED BY MANUFACTURING

Employment is one measure of the benefits from forest industry in the Puget Sound Area. Another measure frequently used to reflect economic benefit to a community from its manufacturing base is "value added by manufacturing." Value added by manufacturing of timber products is, in general, the *net increase in product value added by the manufacturing process.*[1] The following tabulation based on the 1963 Census of Manufacture (preliminary report), shows the estimated value added by manufacturing per employee for the two principal industries:

Paper and allied products (SIC 26)	$18,218
Lumber and wood products (SIC 24)	8,358

In 1963, the total value added by the manufacture of forest products was $350 million (1963 dollars) in the Puget Sound Area. Half of this value added was generated by the paper and allied products industry. The forest industries of the central division accounted for 67 percent ($235 million) of the total value added; the west division 22 percent ($76 million); and the north, only 11 percent ($39 million). The paper and allied products industry produced more than half the value added in the west division whereas the lumber and wood products industry contributed the most in the central division. The two forest industries generated about the same amount of value added by manufacturing in the north division.

[1] See formal definition in Appendix B.

TABLE 1. Distribution of employees within subregions by industry group, 1964 [1]

Industry Group	Subregion North	Subregion Central	Subregion West
	Percent of subregion employment		
Logging, SIC 2411	20	10	8
Sawmills & planing mills, SIC 2421	12	26	15
Veneer & plywood plants, SIC 2432	20	18	31
Miscellaneous lumber & wood products, SIC 24, except 2411, 2421, 2432	18	16	6
Paper and allied products, SIC 26	30	30	40
TOTAL	100	100	100

[1] Source: Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters. Administrative Report. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. September, 1966.

FUTURE ECONOMY, 1963–2020

In this section of the report, estimates of the future level of wood consumption and employment are made for the Puget Sound Area. These estimates are broken down by major forest industry groups and by division. Because the principal markets for the Area's timber products lie outside the State and are widely distributed over the Nation, the future forest industry will be strongly influenced by national demand. National demand for wood products has been projected in the Forest Service report, "Timber Trends in the United States", and this projection was related to estimates of available timber supply in the report, "Prospective Economic Developments Based on the Timber Resources of the Pacific Northwest".[2] Since these two studies were completed, new economic information has been obtained concerning timber demand and supply. The estimates of available timber supply in western Washington have increased due to updating of inventory information and the decision of the State of Washington and the Bureau of Indian Affairs to increase allowable cut levels. The increasing world-wide demand for wood products, especially in the Pacific rim countries, assures a continual high level of demand for wood from the

[2] Gedney, Newport, and Hair. 1966. A specially prepared report under cooperative agreement with the Bonneville Power Administration as a part of their "Pacific Northwest Base Study for Power Markets".

Pacific Northwest.[1 2] This tends to support the concept that future production of forest products will be most limited by the economically available timber supply (Gedney, et al. 1966). Thus, it is assumed that the predicted higher levels of roundwood production will be marketed in the future.

The future production of wood products in the Puget Sound Area was developed on the basis of these assumptions.

ASSUMPTIONS UNDERLYING NATIONAL PROJECTIONS

It is necessary to know the assumptions underlying the national projections because of the importance of national demand as related to the Puget Sound Area. The projections were based on five major factors. These included population, household information, gross national product, disposable personal income, and construction activity.[3]

Population.—By 1985, population of the United States is expected to rise to about 260 million persons and to 325 million by the year 2000. The projection approximates the median of a series of projections published by the U.S. Bureau of the Census (1964) and is roughly 10 percent lower than that of the preceding series prepared in 1960 for the Senate Select Committee on Water Resources.

Households.—Households in the United States have been projected to increase from 54.7 million in 1962 to 101 million in 2000 (Table 17). The number of persons per household is expected to continue to decline, from 3.41 in 1963 to 3.22 in 2000.

Gross national product.—Based on an increased population, recent trends in productivity and other factors, the gross national product is projected to increase 2.2 times, to $1,175 billion (1961 dollars) by 1985, and will continue to rise to $1,920 billion by the year 2000.

Disposable personal income.—Disposable personal income in 1962 was $379 billion (1961 dollars), is expected to rise to $960 billion in 1990, and to $1,340 billion in 2000 (Figure 2). Disposable personal income per capita is expected to more than double between 1962 and the year 2000, rising from $2,030 to $4,120 (1961 dollars) (Table 17).

Construction activity.—Past trends in use and statistical analysis of historical relationships indicate that the use of industrial raw materials will rise about 1.5 times by the year 1985. Four-fifths of the annual consumption of lumber and plywood, nearly all of the poles and piling, and substantial quantities of other industrial timber products are used for construction activity in the United States. Construction expenditures are expected to double by 1985, and the consumption of construction materials is expected to increase 55 percent during the same period. It was assumed that the relative price of timber products and competing materials would remain stable, and therefore industrial timber products would maintain their relative position in the mix of industrial materials—about 22 percent.

INCREASE EXPECTED IN NATIONAL DEMAND FOR TIMBER PRODUCTS

From these basic assumptions, demands for timber products have been projected to 1985 for the United States as shown in Table 18. The total demand for lumber is expected to rise from 37.3 billion board feet in 1962 to 45.5 billion board feet in 1985, an increase of 22 percent for the 23-year period. Even though total demand is increasing, lumber demand per capita is expected to decline to 175 board feet.

Plywood and veneer demand should double by 1985 to 24.2 billion square feet (3/8 inch basis). In 1962, 77 percent of the plywood and veneer was softwood; in the next few decades, softwoods will

[1] The FAO has prepared a report titled "Wood: World Trends and Prospects". This study shows that by 1975 the big net importers of wood will be northeastern Europe, Japan, and the United States. Canada, the USSR, and Scandinavia are expected to increase their export of pulp products and sawn softwoods [Unasylva Vol. 20 (1-2), numbers 80-81, 1966].

[2] Mr. A.D. Stevenson in an article titled "The Timber Importer" printed in The Australian Timber Journal (October 1965), stated that, " In 1964, we (Australia) imported 226 million super feet of softwoods from the West Coast of North America, principally Douglas-fir (Oregon), together with smaller quantities of Canada pine (hemlock and balsam), western red cedar and Californian redwood . . . However, the huge and ever-increasing American domestic market lies virtually astride our supply lines, and it is anyone's guess as to whether and for how long we can expect to be able to compete with it for a guaranteed supply of this valuable wood at present rates, let alone the increase which our own foresters tell us we are going to need from somewhere."

[3] Only the highlights of the projection information are presented here; for additional detail, the two Forest Service reports previously referred to should be reviewed.

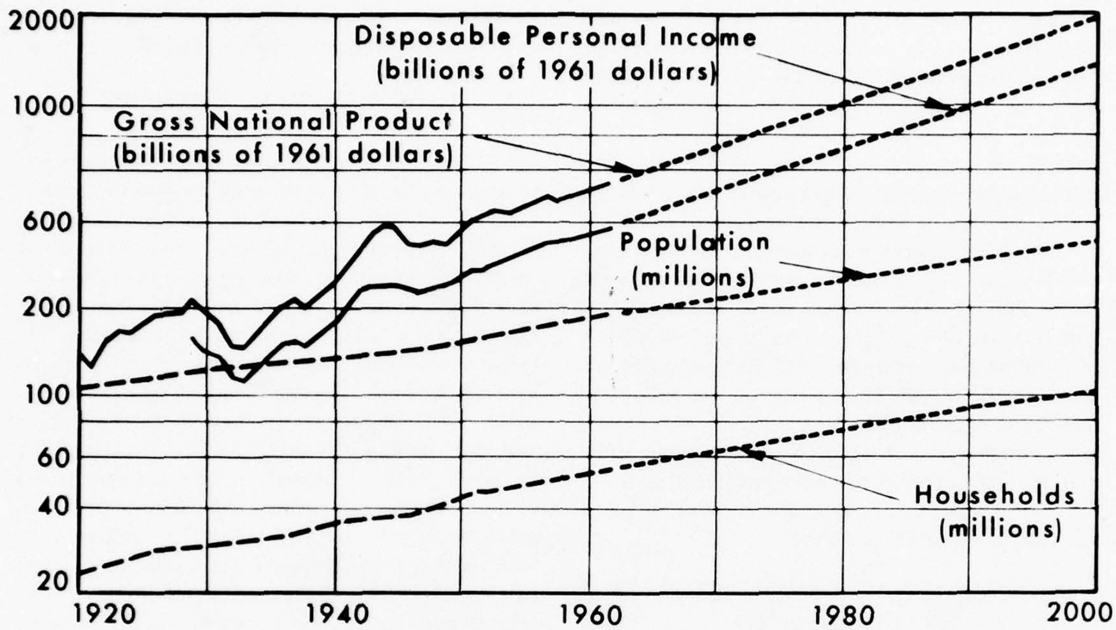

FIGURE 2. Population and economic growth in the United States, 1920-2000. Source: Timber Trends in the United States, p.6.

maintain this percentage of total demand. Historically, most of the softwood veneer and plywood products have come from the west coast, but the South can be expected to supply an increasing share of the demand in the future.

Unlike lumber, plywood's demand per capita is increasing and is expected to reach 93 square feet (3/8-inch basis) by the year 1985. Demand for woodpulp should double, while that for paper and board should nearly double during the same period. Paper and board demand per capita should rise to 609 pounds in 1985. Although the domestic forests are expected to meet most of the increase in future demand, net imports of lumber, veneer logs, and pulpwood are nevertheless expected to increase in the future—a source of competition in domestic markets.

In 1985, domestic lumber production is projected to be 39.4 billion board feet (International ¼-inch Rule). Domestic plywood and veneer production, in terms of log requirements, is projected to be 11.6 billion board feet. Domestic pulpwood production will be about 88 percent of the pulpwood consumption equivalent at the end of the 23-year projection period (Table 19). The projections indicate that the consumption of minor industrial products will remain about the same, while the consumption of fuelwood is expected to decline.

ADDITIONAL ASSUMPTIONS APPLICABLE TO PUGET SOUND AREA

In addition to the previous assumptions, additional assumptions regarding trends in forest management, allowable and prospective cuts from public and private lands, land use, and productivity rates were made for the regional analysis, "Prospective Economic Developments Based on the Timber Resources of the Pacific Northwest." These apply also to the Puget Sound Area.

Trends in forest management—It was assumed that the trend of an increasing level of forest management including protection, reforestation, utilization, and intermediate timber harvests would continue.

Allowable cuts from public lands—The estimates of future cuts from public lands—National Forests, State, and Bureau of Land Management—are planned levels of cut based on each agency's estimates of future conditions. They generally take into account expectations of an increased intensity of management on the lands under their control.

Prospective cut from private lands—This was estimated as the level of cut likely to occur under an extension of past levels of production into the future as modified by changes in the relationship between timber growth and inventory.

Land use—It was assumed that there would be no substantial change in the amount of commercial forest land available for timber production except on the private lands adjacent to Puget Sound.

RAW MATERIAL EXPORTS

It was assumed that the Puget Sound Area will continue to supply a substantial amount of wood in the form of logs to the Orient in the future. The Japanese economy is expected to import most of this roundwood. Present trends in log exports to Japan far exceed those forecast in either of the two recent Forest Service reports. The estimates used in the Puget Sound study are based on the report prepared by G. S. Crawford for the British Research Council, titled "The Japanese Lumber Market" (1965). Although the Puget Sound Area's share of the total projected Japanese export market is expected to decrease in the late 1960's and early 1970's, the absolute volume of log exports is projected to increase above the 1963 levels to the year 1980 and then decline. This downward trend in the 1980's reflects both the anticipated decline in the Japanese export market and the increasing domestic demand for softwood in the United States.

TIMBER SUPPLY WILL LIMIT FUTURE AREA PRODUCTION

The Forest Service reports, "Timber Trends in the United States" and "Prospective Economic Developments Based on the Timber Resources of the Pacific Northwest", show that a substantial share of the future national demand for timber will be for the kind of large, high-quality softwood timber found in western Washington and processed in the Puget Sound Area. The increasing national demand for pulp and paper products will, in turn, create more demand in the future for wood fiber by the Area's large paper and allied products industry, bringing about more intensive utilization of cull logs, young growth, and mill residue. Only a small part of the output in western Washington and the Area is consumed locally, with most of it going to national markets.

The forest industry in the Puget Sound Area is highly developed and diversified, therefore it is expected that it will continue to serve national markets in the future. Under these conditions, it is assumed that all of the economically available supply of timber in the Area will be easily absorbed by the growing demands of the Nation and also by the more immediate demands of the Pacific rim countries. Thus, the available supply of timber in western Washington is the key to the future forest economy of the Puget Sound Area.

The projections of future available timber supply are based on the planned allowable cuts on public lands and on the trends of past cutting on private lands. Future harvests are modified by the effects of such cutting on growth and inventory. The estimate of total available volume includes live, sound trees, and the usable portions of cull and dead trees. Log movements in the Pacific Northwest are included in the projection as well as net log exports. These projected volumes then represent the total volume of roundwood available for consumption by the forest industries.

FUTURE CONSUMPTION

In the projections of wood consumption for the Puget Sound Area, it was assumed that the relative distribution of the various manufacturing processes among the divisions would not change from the 1963 base. Trends toward increasing utilization of small logs, decreasing mortality, and changes in volume and use of residue were also considered in projecting future wood consumption to the year 2020.

Total wood consumption in the Puget Sound Area is expected to increase 44 percent from 647 million cubic feet in 1965 to 931 million cubic feet in 2020. However, wood consumption is projected to increase until 2010 after which a slight decline is expected to the year 2020. The use of residues will increase in the future. In 1963, residues made up 20 percent of the total wood consumed in the Puget Sound Area, in 2020, this portion of total consumption is projected to be 35 percent. Thus, increasing use of residue is an important factor in achieving a large increment in wood consumption during the projection period (Table 13).

TOTAL ROUNDWOOD CONSUMPTION TO DECLINE AFTER 2000

The consumption of roundwood is estimated to increase 13 percent (51 million cubic feet) from 406 million cubic feet in 1965 to 457 million cubic feet in 2000. Roundwood consumption is expected to decline slightly to 445 million cubic feet by 2010 and to drop to 385 million cubic feet by the year 2020 (Table 13).[1]

SAW-LOG CONSUMPTION AND LUMBER PRODUCTION TO DECLINE

The consumption of saw-logs was 232 million cubic feet in 1965. Following an initial drop to 191 million cubic feet by 1970, consumption is projected to remain fairly stable through the year 2020. By projection period, consumption is expected to be 178 million cubic feet in 1980, 185 million in 2000, and 155 million in the year 2020. The total projected decrease in consumption between 1965 and 2020 will be 77 million cubic feet (33 percent) (Table 13).

The amount of lumber produced per cubic foot of saw log consumed will decline in the Puget Sound Area in the future due to the use of smaller trees. As a result, the board-foot volume will decline 47 percent between 1965 and 2020. In 1965, it was estimated that 1,434 million board feet of lumber were produced, whereas in 2020, it is expected that 766 million board feet of lumber will be produced. This trend in output of lumber in the Puget Sound Area is counter to the forecast of national trends.

CONSUMPTION OF VENEER LOGS TO INCREASE LESS THAN THE NATIONAL AVERAGE

By the year 2000, national veneer log consumption will nearly triple, while the Area's consumption will only double. Like the rest of the Pacific Northwest, the Puget Sound Area's veneer and plywood industry is not expected to grow quite as rapidly as national demand because of the development of the softwood veneer and plywood industry in the South.

[1] Roundwood consumption includes log exports classed as miscellaneous wood products.

As shown in Table 13, veneer log consumption in the Puget Sound Area amounted to 93 million cubic feet in 1965. Consumption is expected to be 156 million cubic feet in the year 2000 and increase to 179 million in 2020.

CONSUMPTION OF PULPWOOD TO DOUBLE BY 2020

Consumption of pulpwood in both the Puget Sound Area and the Pacific Northwest is expected to increase more than the national average. The proximity of sawmills, plywood plants, and pulpmills to each other in the Puget Sound Area has made mill residues a relatively low cost raw material for the pulp industry. The waters of Puget Sound have made it feasible to transport large volumes of residue to the pulpmills at low cost. An example of such movement is the transporting of chips from British Columbia to Tacoma. Mill residues also move long distances by both truck and rail to the Puget Sound Area. Chip movements from Libby, Montana to Tacoma is an example of this type of residue transportation.

Estimated total consumption of wood fiber by the paper and allied products industry in the Puget Sound Area will increase from 241 million cubic feet in 1965 to 546 million cubic feet in 2020—an increase of 127 percent (Table 15). In 1965, the consumption of round pulpwood amounted to 111 million cubic feet while residue consumption was 130 million cubic feet. By 2020, round pulpwood consumption will have increased to an estimated 211 million cubic feet and residue consumption will total 335 million cubic feet. A large proportion of the residue consumed in the future will come from areas which lie outside the study area.

MISCELLANEOUS WOOD PRODUCTS CONSUMPTION TO FLUCTUATE WIDELY

The national projections show that little increase is expected in the use of miscellaneous wood products such as poles, pilings, fenceposts, and fuelwood; projections for the Pacific Northwest and the Puget Sound Area follow these same national trends. However, the miscellaneous wood products category in this report, like that for the Pacific Northwest, includes log exports. Log exports are expected to fluctuate widely with changes in international economic conditions, and therefore the Area's projections for the miscellaneous wood products show the Area's expected response to international demand for roundwood.

In 1965, consumption of miscellaneous wood products in the Puget Sound Area amounted to 81 million cubic feet. Consumption is expected to increase to 172 million cubic feet in 1980 and level off through 1990. By 2020, the amount of wood consumed for these products is projected to decline to 51 million cubic feet, 37 percent below what was consumed in 1965, (Table 14).

TOTAL FOREST INDUSTRY-BASED EMPLOYMENT TO DECLINE

Forest industry employment has been projected for the period 1965-2020. Projections were made by the following major industry groups: logging, sawmills and planing mills, veneer and plywood plants, paper and allied products, and miscellaneous wood products. It should be noted that employment generated by the export of logs has been added to the miscellaneous wood products category (SIC 24, except 2411, 2421, 2432). With the exception of employment in the export of logs, the employment data are based on statistics which include only those workers directly employed by wood-using industries as reported by the Employment Security Department as covered employment. No attempt was made to include other less direct employment, such as for servicing equipment used in wood products industries.

Productivity of workers in the forest industry has been increasing due to automation and mechanization. The result of this increase has been a reduced employment per unit of production. It is expected that productivity will continue to increase in the future, although at a slower rate. Employment projections for the Area were made by applying productivity trends for specific industries to the estimates of thier log consumption for the study period.

The changes in forest product manufacturing brought about by changes in effective demand and raw material supply, plus changes in worker productivity, will cause total forest industry employment to decline 30 percent between 1965 and 2020. In 1965, the Puget Sound Area employed 31,300 workers in the forest industry, including timber exports. Employment is projected to gradually decline to 21,900 workers in the year 2020 (Table 16).

The lumber and wood products industry (SIC 24 plus exporting) accounts for the decline. Every category within this industry is projected to have reduced employment in the future. The total lumber and wood products industry employed 21,500 workers in 1965, but employment will drop 41 percent by 2020 to 12,600. Sawmill and planing mill employment will drop the most–5,200 persons or 80 percent. The next largest decrease is expected to be in the logging industry–2,100 workers or 47 percent. Veneer and plywood employment will be lower by 1,600 workers (26 percent) in the year 2020. Other lumber and wood products employment is expected to remain about the same in 2020 as it was in 1965.

Employment will increase rapidly in the paper and allied products industry (SIC 26) between 1965 and 1990, and then level off. In 1965, 9,800 people were employed in this industry in the Puget Sound Area. By 1990, 2,000 more employees will be added to make a total of 11,800–an increase of 20 percent. Employment is then projected to decline to 10,900 workers by the year 2000 and to 9,300 workers by 2020.

DISTRIBUTION OF EMPLOYEES WITHIN DIVISIONS TO CHANGE

All three divisions will have a decrease in the proportion of workers in logging, sawmills and planing mills, and veneer and plywood plants but will have a slight increase in the proportion of workers in the miscellaneous wood products category (including log exporting). All three divisions will have large increases in the paper and allied products industry. These trends are based in part on the assumption that the relative distribution of industry groups among divisions will remain essentially constant during the projection period (Table 2).

The central division will continue to be the most important segment of the Area's forest economy in 2020. This division will have the most employees in the Area and the majority of these will be employed by the paper and allied products industry. Its forest industries will generate more value added by manufacturing to the Area's forest economy than other divisions.

The increasing importance of the paper and allied products industry in the Area along with advanced manufacturing, marketing, and management techniques by the other industries means that the forest economy of the Area will tend to become more and more stable over time. In part, this reflects an assured timber supply stemming from the forest management policies being practiced presently by both the private and public owners of forest land in western Washington.

TABLE 2. Distribution of employees within divisions by industry group, 1965 and 2020[1] (in percent)

Industry Group	North Division 1965	North Division 2020	Central Division 1965	Central Division 2020	West Division 1965	West Division 2020
Logging	22	17	15	12	10	7
Sawmills and planing mills	14	3	24	7	16	5
Veneer and plywood plants	24	23	19	21	18	17
Miscellaneous wood products plus log exportings	14	20	14	21	14	19
Paper and allied products	26	37	28	39	42	52
Total	100	100	100	100	100	100

[1] Source: Wall, Brian R., *Projected Developments in the Timber Economy of the Columbia-North Pacific Region.* Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 1969.

FUTURE TIMBER RESOURCE

CHANGE IN INVENTORY TO CONTINUE

In the first half of this century the objective of forest management in the Puget Sound Area was essentially to remove the large, old-growth timber. The inventory volume became smaller and smaller as the accumulated growth of hundreds of years was harvested. This section of the report will show how dynamic the forest resource is and the change anticipated in the future based on present trends in forest management.

Since a large amount of the old growth has been felled, the decline in inventory volume will be slower in the future than in the past. During the period 1968 to 2020, inventories of sawtimber in the Puget Sound Area will decline 16 percent. In 2020, this inventory is expected to be 84,760 million board feet (International ¼-inch Rule). It was estimated to be 100,850 million board feet in 1968. The following tabulation shows the change in inventory volume on commercial forest land in the Area.

Owner	1968	2020	Change
	(MMBF, Int. ¼-in. rule)		%
National Forest	51,560	28,874	-44
Other public	14,380	25,165	+75
Private	34,910	30,721	-12
TOTAL	100,850	84,760	-16

Inventory reductions will continue to take place with the continued harvesting of the large, mature and overmature timber. The National Forests with the largest backlog of old-growth timber will reduce their inventory by 44 percent. Private owners are expected to reduce their inventory by 12 percent, while the other public owners' sawtimber inventory will increase 75 percent by 2020. These inventory changes are based on projections for western Washington, and it is assumed that they are representative of the conditions in the Puget Sound.

Table 3 shows the increasing proportion of growing-stock volume in the small diameter classes resulting from anticipated cutting practices. In 1963, 48 percent of the total growing-stock inventory on private lands was between 6 and 18 inches in diameter; this proportion of small trees will increase to 67 percent by 2020.

In that same year, 97 percent of the private inventory will be under 28 inches in diameter. The distribution of growing stock will be altered on the other public lands also. Here, 46 percent of the inventory was in a diameter range of 6 to 18 inches in 1963, and the proportion in this range will increase to 59 percent in 2020. The growing stock in the 20 to 28-inch class is expected to increase to 42 percent in 2020. The part of the inventory in the 20 to 28 inch class will increase slightly to the year 2020, while the proportion in larger trees will be reduced.

In the Puget Sound Area, net annual growth is projected to increase from 376 million cubic feet in 1963 to 467 million cubic feet in 2020. Under the assumptions made, net annual growth generally increases to the year 1990, and then levels off as growth and cut come more into balance. The projected increments in growth reflect the large increases in growth rates experienced, especially on the public lands, with the reduction of old-growth stands and the substitution of faster growing young trees (Table 9).

TABLE 3. Distribution of western Washington growing-stock volume by diameter and owner class, 1963-2020[1] (In percent)

	National Forest		Private		Other Public	
Diameter By 2-Inch Class	1963	2020	1963	2020	1963	2020
6-10	7	13	20	23	19	14
12-18	18	29	28	44	27	45
20-28	28	30	23	30	21	37
30-38	23	16	13	3	15	4
40-48	13	6	7	*	10	*
50-58	6	3	4	*	4	*
60+	5	3	5	*	4	*
Total	100	100	100	100	100	100

[1] Source: Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters. Administrative Report. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. September, 1966.

*Less than 1 percent.

APPENDIX A

TABLES

TABLE 4. Land area of the Puget Sound Area by divisions, county, and forest land class, 1968 (In thousand acres)
(In thousand acres)

Division & county	Total land area[1]	Total forest land	Forest land: Productive (commercial)	Unproductive	Productive reserved
NORTH					
Island	134	90	85	---	5
San Juan	112	77	69	---	8
Skagit	1,118	864	700	103	61
Whatcom	1,352	960	602	243	115
TOTAL	2,716	1,991	1,456	346	189
CENTRAL					
King	1,357	967	839	111	17
Lewis	141	127	125	2	---
Pierce	1,032	809	628	77	104
Snohomish	1,339	1,051	833	147	71
Kitsap	253	210	210	---	---
TOTAL	4,122	3,164	2,635	337	192
WEST					
Clallam	378	325	163	69	93
Jefferson	482	370	225	81	64
Mason[2]	473	401	347	33	21
Thurston	264	178	178	---	---
TOTAL	1,597	1,274	913	183	178
ALL DIVISIONS	8,435	6,429	5,004	866	559

[1]Based on data presented by the Land Usage and Development Committee, Puget Sound and Adjacent Waters Task Force, June 28, 1966. 2

[2]*Includes small area in Grays Harbor County.*

TABLE 5. Area of commercial forest land in the Puget Sound Area by division, county, and ownership class, December, 1968. (In thousand acres)

Division & county	Total	Ownership Class: National forest	Other public	Private
NORTH				
Island	85	---	2	83
San Juan	69	---	---	69
Skagit	700	198	151	351
Whatcom	602	213	141	248
TOTAL	1,456	411	294	751
CENTRAL				
King	839	216	129	494
Lewis	125	38	13	74
Pierce	628	116	83	429
Snohomish	833	297	144	392
Kitsap	210	--	21	189
TOTAL	2,635	667	390	1,578
WEST				
Clallam	163	63	45	55
Jefferson	225	70	18	137
Mason[1]	347	82	59	206
Thurston	178	1	33	144
TOTAL	913	216	155	542
ALL DIVISIONS	5,004	1,294	839	2,871

[1]*Includes small area in Grays Harbor County.*

TABLE 6. Area of commercial forest land in the Puget Sound Area by division, county, and stand-size class, December 1968. (In thousand acres)

Division & county	Total	Stand-size class: Sawtimber	Poletimber	Saplings & seedlings	Non-stocked
NORTH					
Island	85	44	36	5	---
San Juan	69	33	28	8	---
Skagit	700	410	188	91	11
Whatcom	602	376	160	51	15
TOTAL	1,456	863	412	155	26
CENTRAL					
King	839	515	236	79	9
Lewis	125	93	5	27	---
Pierce	628	324	204	89	11
Snohomish	833	490	254	77	12
Kitsap	210	104	83	22	1
TOTAL	2,635	1,526	782	294	33
WEST					
Clallam	163	67	82	13	1
Jefferson	225	149	63	13	---
Mason[1]	347	104	125	111	7
Thurston	178	21	114	40	3
TOTAL	913	341	384	177	11
ALL DIVISIONS	5,004	2,730	1,578	626	70

[1] Includes small area in Grays Harbor County.

TABLE 7. Volume of growing stock and sawtimber on commercial forest land in Puget Sound Area by division and owner group, 1968.

Division & owner group	Growing stock Million cubic feet	Sawtimber International ¼-inch rule Million board feet	Division & owner group	Growing stock Million cubic feet	Sawtimber International ¼-inch rule Million board feet
NORTH			WEST		
National forest	2,868	13,525	National forest	1,551	8,588
Other public	1,417	6,359	Other public	221	836
Private	2,226	9,738	Private	1,142	4,328
TOTAL	6,511	29,622	TOTAL	2,914	13,752
CENTRAL			ALL DIVISIONS		
National forest	5,961	29,449	National forest	10,380	51,562
Other public	1,370	7,183	Other public	3,008	14,378
Private	4,293	20,845	Private	7,661	34,911
TOTAL	11,624	57,477	TOTAL	21,049	100,851

TABLE 8. Volume of growing stock and sawtimber on commercial forest land in the Puget Sound Area by species and division, December 1968.

Species	Division North	Division Central	Division West	Total	Species	Division North	Division Central	Division West	Total
Growing stock	Million cubic feet				Sawtimber	Million board feet, International ¼-inch rule			
Douglas-fir	1,285	3,258	1,579	6,122					
Western hemlock	1,694	3,664	678	6,036	Douglas-fir	6,021	18,948	8,630	33,599
True firs	2,206	2,241	130	4,577	Western hemlock	9,028	18,609	3,342	30,979
Sitka spruce	46	33	2	81	True firs	11,138	13,320	846	25,304
Other softwoods	679	1,449	255	2,383	Other softwoods	1,970	3,975	343	6,288
TOTAL	5,910	10,645	2,644	19,199	TOTAL	28,157	54,852	13,161	96,170
Red alder	425	727	210	1,362	Red alder	952	1,667	400	3,019
Other hardwoods	176	252	60	488	Other hardwoods	513	958	191	1,662
TOTAL	601	979	270	1,850	TOTAL	1,465	2,625	591	4,681
ALL SPECIES	6,511	11,624	2,914	21,049	ALL SPECIES	29,622	57,477	13,752	100,851

TABLE 9. Trend of net annual growth of growing stock and sawtimber on commercial forest land of the Puget Sound Area by Division, 1963-2020 [1]

Year	Growing stock North	Central	West	Total	Sawtimber (International ¼-inch rule) North	Central	West	Total
	Million cubic feet				Million board feet			
1963	113	211	52	376	391	810	156	1,357
1970	125	234	56	415	444	918	177	1,539
1980	135	251	61	447	501	1,031	199	1,731
1990	140	258	64	462	533	1,095	214	1,842
2000	141	260	65	466	545	1,116	221	1,882
2010	142	260	65	467	545	1,115	223	1,883
2020	141	261	65	467	543	1,106	223	1,872

[1] Source: Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters. Administrative Report. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. September, 1966.

TABLE 10. Annual log production in the Puget Sound Area by owner class and county, 1950-63 (International ¼-inch rule) (in thousand board feet)

Owner class and county	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
All Counties														
Private	1.386.786	1.318.698	1.251.262	1.078.742	1.021.698	1.061.957	1.196.183	885.023	773.937	1.030.426	1.126.086	933.037	1.020.144	986.404
National Forest	283.599	317.553	308.114	361.760	329.417	327.080	372.739	407.209	445.794	587.120	493.568	445.770	566.320	594.578
Other public	69.902	58.788	100.576	633	3.889	180.053	230.378	121.727	44.080	113.468	89.627	84.618	115.340	245.486
Total	1.740.287	1.695.039	1.659.952	1.441.135	1.355.004	1.589.090	1.799.300	1.413.959	1.263.811	1.731.014	1.709.281	1.463.425	1.701.804	1.826.470
Clallam County [1]														
Private	1.306	1.190	1.323	1.012	1.144	1.271	1.461	1.478	1.123	1.752	1.952	1.737	1.290	1.743
National Forest	15.002	19.917	8.867	57.053	55.746	36.788	17.672	10.427	13.364	18.767	13.203	15.255	20.173	30.004
Other public	271	116	75	190	840	348	440	212	82	513	442	441	405	703
Total	16.579	21.223	10.265	58.255	57.730	38.407	19.573	12.117	14.569	21.032	15.597	17.433	21.868	32.450
Island County														
Private	19.578	24.058	27.423	24.344	20.435	27.291	16.030	25.602	18.416	22.084	23.512	20.784	15.132	19.743
National Forest	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other public	...	529	2.141	...	...	...	250	...	...	...	2.628	34	...	502
Total	19.578	24.587	29.564	24.344	20.435	27.291	16.280	25.602	18.416	22.084	26.140	20.818	15.132	20.245
San Juan County														
Private	24.911	22.887	21.226	18.092	16.589	19.728	32.812	8.591	6.348	10.994	9.498	6.756	6.748	4.625
National Forest	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other public	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	24.911	22.887	21.226	18.092	16.589	19.728	32.812	8.591	6.348	10.994	9.498	6.756	6.748	4.625
Jefferson County [1]														
Private	27.044	41.048	34.535	14.005	17.608	26.936	29.035	24.872	18.267	35.130	27.166	33.341	27.336	28.702
National Forest	9.250	13.396	26.473	25.643	25.515	29.980	26.600	35.506	34.953	43.540	39.096	31.134	45.290	52.627
Other public	145	26	212	...	...	2.068	1.411	1.123	961	962	1.541	1.874	2.263	2.760
Total	36.439	54.470	61.220	39.648	43.123	58.984	57.046	61.501	54.181	79.632	67.803	66.349	74.889	84.089
King County														
Private	201.012	224.505	252.159	206.677	233.947	276.641	298.112	238.102	246.563	201.323	330.483	223.746	253.206	190.264
National Forest	21.605	32.106	40.314	34.158	5.552	10.386	21.364	35.792	25.739	30.287	33.915	21.360	24.502	58.540
Other public	7.141	1.207	3.553	...	...	19.173	52.066	10.583	898	1.486	6.219	12.458	22.070	44.359
Total	229.758	257.818	296.026	240.835	239.499	306.200	371.542	284.477	273.200	233.096	370.617	257.564	299.778	293.163
Kitsap County														
Private	82.756	108.959	71.792	33.493	29.224	33.320	61.977	41.404	30.262	43.024	32.954	33.977	24.184	18.434
National Forest	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other public	853	115	66	43	607	...	3.432	1.779	124		896	751	1.308	4.483
Total	83.609	109.074	71.858	33.536	29.831	33.320	65.409	43.183	30.386	43.024	33.850	34.728	25.492	22.917
Mason County [1]														
Private	96.395	72.802	39.858	55.614	62.236	67.100	58.462	56.100	38.088	52.428	53.494	57.522	50.556	44.097
National Forest	2.225	10.836	40.249	26.510	10.643	442	66.469	67.607	83.946	84.088	82.348	37.308	57.374	62.407
Other public	6.030	481	32	...	...	2.513	590	1.180	212	1.047	910	3.257	5.872	1.663
Total	104.650	84.119	80.139	82.124	72.879	70.055	125.521	124.887	122.246	137.563	136.752	98.087	113.802	108.167
Pierce County														
Private	227.952	190.238	243.620	174.824	172.781	215.837	231.982	199.160	177.026	321.993	280.935	270.721	315.748	298.550
National Forest	32.106	49.728	37.900	25.468	36.451	24.937	31.382	30.237	28.684	29.913	28.745	40.296	48.521	51.418
Other public	...	...	86		157	36.265	52.645	767	3.255	33.505	2.922	18.729	16.420	40.040
Total	260.058	239.966	281.606	200.292	209.389	277.039	316.009	230.164	208.965	385.411	312.602	329.746	380.689	390.008
Lewis County [1]														
Private	87.239	110.146	74.208	95.801	74.387	64.593	66.798	56.026	52.182	62.390	45.704	36.616	54.819	53.331
National Forest	13.067	13.900	8.989	11.999	11.081	15.904	12.149	6.880	18.031	33.506	29.658	26.664	30.448	32.159
Other public	7.141	357	10.485		122	14.820	19.439	11.121	18.413	4.056	10.419	8.167	7.915	9.220
Total	107.447	124.403	93.682	107.800	85.590	95.317	98.386	74.027	88.626	99.952	85.781	71.447	93.182	94.710
Skagit County														
Private	215.923	205.065	134.139	138.327	107.559	99.265	77.643	55.678	67.015	69.638	101.706	80.271	74.966	78.935
National Forest	28.968	25.588	24.502	43.935	21.243	62.689	44.297	54.883	69.395	119.579	97.072	65.342	75.558	65.178
Other public	18.937	19.160	31.389		844	50.011	30.708	37.927	4.658	14.657	16.557	14.492	23.891	21.958
Total	263.828	249.813	190.030	182.262	129.646	211.965	152.648	148.488	141.068	203.874	215.335	160.105	174.415	166.071
Snohomish County														
Private	147.909	137.552	139.535	140.173	101.542	97.753	128.157	82.182	46.496	97.215	130.024	95.428	126.217	151.167
National Forest	89.077	93.784	98.370	83.645	96.922	85.716	80.145	50.040	93.613	123.074	106.401	136.311	182.619	163.548
Other public	15.766	9.576	27.017	117	404	27.563	41.358	37.948	9.248	41.309	31.992	16.309	8.428	71.158
Total	252.752	240.912	264.922	223.935	198.868	211.032	249.660	170.170	149.357	261.598	268.417	248.048	317.264	385.873
Thurston County [1]														
Private	80.196	67.348	78.253	37.454	61.321	71.514	85.030	49.776	37.182	39.985	28.449	24.526	30.420	44.106
National Forest														
Other public	1.656	688	80	44	87	1.947	6.936	3.797	1.222	1.135	858	703	828	4.006
Total	81.852	68.036	78.333	37.498	61.408	73.461	91.966	53.573	38.404	41.120	29.307	25.229	31.248	48.112
Whatcom County														
Private	174.565	112.900	133.191	138.926	122.925	80.708	108.684	46.052	34.969	72.470	60.209	47.612	39.522	52.709
National Forest	72.299	58.298	22.450	53.349	66.264	60.238	72.661	115.837	78.069	104.366	63.130	72.100	81.835	78.697
Other public	11.962	26.533	25.440	239	828	25.345	21.103	15.290	5.007	14.798	14.243	7.403	25.940	44.634
Total	258.826	197.731	181.081	192.514	190.017	166.291	202.448	177.179	118.045	191.634	137.582	127.115	147.297	176.040

[1] Estimated volumes for the portion of the county in the Puget Sound Area

Source: Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters. Administrative Report. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 1966

TABLE 11. Output of timber products in Puget Sound Area by division and county, 1963. [1]

Division and county	Lumber [2]	Plywood [3]	Miscellaneous products [4]	Woodpulp [5]
	Thousand bd. ft	Thousand sq. ft.	Thousand cu. ft.	Tons
NORTH:				
Island	9,600	0	200	0
San Juan	2,500	0	0	0
Skagit	67,300	150,000	5,900	31,000
Whatcom	31,800	60,000	5,800	155,200
TOTAL	111,200	210,000	11,900	186,200
CENTRAL				
King	328,500	174,000	5,300	0
Kitsap	76,000	0	1,300	0
Lewis	0	0	100	0
Pierce	150,500	360,500	20,100	310,500
Snohomish	384,400	228,200	18,000	527,800
TOTAL	939,400	762,700	44,800	838,300
WEST				
Clallam	65,900	87,000	10,800	341,500
Jefferson	6,600	0	100	124,500
Mason	154,400	18,000	2,600	31,000
Thurston	47,300	179,000	4,900	0
TOTAL	274,200	284,000	18,400	496,700
ALL SUBREGIONS	1,324,800	1,256,700	75,100	1,521,200

[1] Source: Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters. *Administrative Report.* Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. September, 1966.

[2] Western Wood Products Assoc. Statistical Yearbook. 1963.

[3] Forest Industries 33rd Annual Plywood Review. 1964.

[4] Based on unpublished file data of the Pacific Northwest Forest & Range Exp. Sta. (includes piling, poles, posts, fuelwood, ties, excelsior, shingles, log exports, etc.).

[5] Production based on data reported by the Northwest Pulp and Paper Assoc. and allocated on the basis of capacity listed in Lockwood's Directory.

TABLE 12. Number of forest industry establishments and average annual employment by industry groups, divisions and counties in the Puget Sound Basin, 1964 [1,7]

Division and county	Logging SIC 2411		Sawmills and planing mills SIC 2421		Veneer and plywood plants SIC 2432		Miscellaneous lumber and wood products SIC 24 except 2411,2421,2432		Paper and allied products SIC 26	
	Reporting unit	No. of employees	Reporting unit	No. of employees	Reporting unit	No. of employees	Reporting unit	No. of employees	Reporting unit	No. of employees
North:										
Island	5	10	5	20	0	0	[2]	0	0	0
San Juan	2	370	4	10	0	0	0	0	0	0
Skagit	56		7	170	1	[3]	26[2]	340	1	[3]
Whatcom	41	300	7	220	2	[3]	13	270	5	[3]
Total	104	680	23	420	3	710	39	610	6	1,040
Central:										
King	68	610	31	1,690	7	1,280	63	1,180	27	1,070
Snohomish	103	570	32	1,920	4	680	48	1,010	3	3,120
Lewis	[4]	180[5]	0	0	0	0	0	0	0	0
Pierce	41	620	25	1,290	7	1,650	42	1,060	14	1,840
Kitsap	23	40	14	230	0	0	3	70	0	0
Total	235	2,020	102	5,130	18	3,610	156	3,320	44	6,030
West:										
Clallam	[4]	90[5]	11	230	1		12	240	3	[3]
Jefferson	[4]	60[5]	9	40	2	850	4	50	1	[3]
Mason	[4]	260[5]	14	430	1		4	20	2	[3]
Thurston	[4]	90[5]	22	220	5	1,090	4	70	3	1,120
Total	[6]	500	56	920	9	1,940	24	380	9	2,490
All Divisions	[6]	3,200	181	6,470	30	6,260	219	4,310	59	9,560

1 These figures are based on Washington Employment Security Dept. data.
2 Island County and Skagit County data are combined to avoid disclosure of individual mill data.
3 Data combined in the subregion's total to avoid disclosure of individual mill data.
4 Data not available on partial county basis.
5 Logging employment data allocated on the basis of estimated log production.
6 Data not available.
7 Source: Wall, Brian R., Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters. Administrative Report. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. September, 1966.

TABLE 13. Estimated total wood consumption by source and use in the Puget Sound Area, 1965-2020. (In million cubic feet).

Year	Total wood consumption	Saw log[1]	Veneer log	Pulp wood[2]	Miscel-laneous products	Log exports
1965	647	343	93	241	22	59
1970	681	191	94	254	25	117
1980	814	178	122	342	30	142
1990	914	158	135	464	36	121
2000	956	185	156	499	36	80
2010	979	188	171	534	36	50
2020	931	155	179	546	31	20

1 Includes peeler cores.
2 Includes chips from slabs and edgings, sawdust, and other mill residue used in pulping.

Source: Wall, Brian R.. Projected Developments in the Timber Economy of the Columbia-North Pacific Region. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, 1969.

TABLE 14. Estimated consumption of roundwood by the lumber and wood, products industry in the Puget Sound Area by division, 1965-2020. (In million cubic feet).

Division & year	Total	Saw logs[1]	Veneer logs	Miscellaneous wood products
ALL DIVISIONS				
1965	406	232	93	81
1970	427	191	94	142
1980	472	178	122	172
1990	450	158	135	157
2000	457	185	156	116
2010	445	188	171	86
2020	385	155	179	51
NORTH				
1965	48	19	16	13
1970	52	15	16	21
1980	62	15	21	26
1990	59	13	23	23
2000	59	15	26	18
2010	56	15	29	12
2020	59	12	30	8
CENTRAL				
1965	270	165	56	49
1970	280	136	58	86
1980	305	126	75	104
1990	290	112	82	96
2000	298	131	96	71
2010	291	134	104	53
2020	251	111	109	31
WEST				
1065	88	48	21	19
1970	95	40	20	35
1980	105	37	26	42
1990	101	33	30	38
2000	100	39	34	27
2010	98	39	38	21
2020	84	32	40	12

[1] Includes peeler cores.

Source: Wall, Brian R., Projected Developments in the Timber Economy of the Columbia-North Pacific Region. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 1969.

TABLE 15. Estimated consumption of wood fiber by the pulp and paper industries in the Puget Sound Area by division, 1965-2020. (In million cubic feet.)

Division and year	Roundwood and residue
ALL DIVISIONS	
1965	241
1970	254
1980	342
1990	464
2000	499
2010	534
2020	546
NORTH	
1965	28
1970	30
1980	41
1990	56
2000	60
2010	64
2020	65
CENTRAL	
1965	134
1970	140
1980	188
1990	255
2000	274
2010	294
2020	301
WEST	
1965	79
1970	84
1980	113
1990	153
2000	165
2010	176
2020	180

Source: Wall, Brian R., Projected Developments in the Timber Economy of the Columbia-North Pacific Region. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 1969.

TABLE 16. Current and projected average annual employment in the Puget Sound Area by industry, by division, 1965–2020[1]

Division & year	Total	Logging SIC 2411	Sawmills and planing mills SIC 2421	Veneer and plywood plants SIC 2432	Miscellaneous lumber and wood products SIC 24 except 2411, 2421 2432	Paper and allied products SIC 26
ALL DIVISIONS	31,300	4,500	6,500	6,100	4,400	9,800
1965	27,900	4,200	4,500	5,400	4,400	9,400
1980	27,300	3,900	3,100	5,600	4,400	10,300
1990	26,900	3,500	2,100	5,100	4,400	11,800
2000	25,600	3,200	2,100	5,000	4,400	10,900
2010	23,800	2,500	1,800	4,800	4,400	10,300
2020	21,900	2,400	1,300	4,500	4,400	9,300
NORTH:						
1965	4,200	900	600	1,000	600	1,100
1970	3,000	900	400	900	600	1,200
1980	3,900	900	300	900	600	1,200
1990	3,800	700	200	900	600	1,400
2000	3,600	700	200	800	600	1,300
2010	3,400	600	100	800	600	1,300
2020	3,000	500	100	700	600	1,100
CENTRAL						
1965	19,200	2,800	4,600	3,700	2,700	5,400
1970	17,000	2,600	3,200	3,300	2,700	5,200
1980	16,400	2,400	2,200	3,400	2,700	5,700
1990	16,000	2,200	1,500	3,100	2,700	6,500
2000	15,300	2,000	1,500	3,100	2,700	6,000
2010	14,100	1,500	1,300	3,000	2,700	5,600
2020	13,000	1,500	900	2,800	2,700	5,100
WEST						
1965	7,900	800	1,300	1,400	1,100	3,300
1970	7,000	700	900	1,200	1,100	3,100
1980	7,000	600	600	1,300	1,100	3,400
1990	7,100	6,000	4000	1,100	1,100	3,900
2000	6,700	500	400	1,200	1,000	3,600
2010	6,300	400	400	1,000	1,100	3,400
2020	5,900	400	300	1,000	1,100	3,100

[1]Source: Wall, Brian R., Projected Developments in the Timber Economy of the Columbia-North Pacific Region. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 1969.

TABLE 17. Population, households, gross national product and disposable personal income in the United States, 1920-2000 [1]

Year	Population	Households	Persons per household	Gross national product (1961 dollars)	Disposable personal income (1961 dollars) Total	Disposable personal income (1961 dollars) Per capita
	Million			Billion		
1920	106.5	24.4	4.36	143.0	--	--
1930	123.2	29.9	4.12	190.3	140.6	1,141
1940	132.1	34.9	3.79	268.8	170.2	1,288
1950	152.3	43.0	3.54	366.5	256.7	1,685
1960	180.7	53.0	3.41	511.1	355.7	1,968
1962	186.7	54.7	3.41	546.0	379.0	2,030
			Projections			
1970	208.0	62.5	3.33	710.0	500.0	2,400
1975	223.0	--	--	84.0	--	--
1980	241.0	73.5	3.28	990.0	690.0	2,860
1985	260.0	--	--	1,175.0	--	--
1990	280.0	86.2	3.25	1,380.0	960.0	3,430
2000	325.0	101.0	3.22	1,920.0	1,340.0	4,120

[1] Based on tables 1 and 2, pp. 6 and 8, "Timber Trends in the United States."

Sources: POPULATION: 1920-40, U.S. Dep. Com., Bur. Census, Historical Statistics of the United States, 1960. 1950-62, "Estimates of the Population of the United States, January 1, 1950, to March 1, 1964."

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NUMBER OF HOUSEHOLDS: 1920-40, Bur. Census, Census of Housing, 1950, vol. I, Part 1, 1953. 1950 and 1960, Bur. Census, "Components of Inventory Change." United States Census of Housing, 1960, vol. IV, Part 1-A, 1962, and from *unpublished data furnished by the Bur. Census. 1962, "Households and Families, by Type: 1962." Population Characteristics,* 1962 (Cur. Population Reps., Ser. P-20, No. 119). Projections, 1970 and 1980, U.S. Dep. Agr., Forest Serv., derived from projections published by the U.S. Dep. Com., Bur. Census, "Interim Revised Projections of the Number of Households and Families: 1965 to 1980". Population Characteristics, 1963 (Cur. Population Reps., Ser. P-20, No. 123). 1990 and 2000, derived from population estimates and assumed trend in number of persons per household.

GROSS NATIONAL PRODUCT: *1920, derived from data published by the Joint Com. Econ. Rep., Potential Economic* Growth of the United States During the Next Decade, 1954. 1930-62, Office of the President, Economic Report of the President, January 1962 and 1964.

DISPOSABLE PERSONAL INCOME: 1930-62, Office of the President, Economic Report of the President, January 1962 and 1964.

PROJECTIONS: U.S. Dep. Agr., Forest Serv., derived in part from data published by the Outdoor Recreation Resources Rev. Comm. Staff, Nat. Planning Ass., and U.S. Dep. Labor, Bur. Labor Statist., Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation, 1962 (ORRRC Study Rep. No. 23).

TABLE 18. Summary of total demand for major timber products in the United States, 1952-1985.

Product	Standard unit of measure	1952	1962	Projections 1970	1975	1980	1985
LUMBER							
total	Mil. bd. ft.[1]	41,460	37,300	39,700	41,600	43,400	45,500
Per capita	bd. ft.[2]	263	200	191	187	180	175
PLYWOOD & VENEER							
softwoods	Mil. sq. ft., 3/8-in. basis	--	9,250	14,400	15,600	17,000	18,500
Hardwoods	Mil. sq. ft., 3/8-in. basis	--	2,770	3,500	4,200	5,000	5,700
TOTAL		--	12,020	17,900	19,800	22,000	24,200
Per Capita	sq. ft.	--	64	86	89	91	93
WOODPULP							
total	Mil. tons	--	29.5	38.2	44.8	52.4	60.5
PAPER & BOARD							
Total	Mil. tons	--	42.4	52.7	60.2	69.3	79.2
Per capita	lbs.	--	454	507	540	575	609

[1]Million board feet
[2]board feet

TABLE 19. Summary of consumption, net imports, and domestic production of timber products in the United States, 1952-85

Product	Standard unit of measure	1952	1962	Projections 1970	1975	1980	1985
Lumber:							
Consumption	Million board feet, International ¼-inch rule	41,460	37,300	39,700	41,600	43,400	45,500
Net imports	"	1,752	4,130	5,100	5,400	5,800	6.100
Domestic production	"	39,708	33,170	34,600	36,200	37,600	39,400
Domestic roundwood[1]	"	39,488	34,105	35,600	37,200	38,600	40,400
Veneer logs:							
Consumption	"	3,082	6,776	10,300	11,300	12,500	13,900
Net imports[2]	"	148	860	1,300	1,600	1,900	2,300
Domestic production	"	2,934	5,916	9,000	9,700	10,600	11,600
Domestic roundwood	"	2,934	5,916	9,000	9,700	10,600	11,600
Pulpwood:							
Consumption[3]	Million standard cords	35.4	52.8	67.5	78.0	88.5	99.5
Net imports	"	11.0	10.1	11.0	11.2	11.5	12.2
Domestic production	"	25.0	42.8	56.6	66.8	77.8	87.3
Domestic roundwood	"	23.4	33.8	42.0	50.8	60.0	69.3
Miscellaneous industrial wood:							
Consumption	Million cubic feet	758	505	500	500	500	500
Net imports	"	--[4]	--[4]	--	--	--	--
Domestic production	"	758	505	500	500	500	500
Domestic roundwood	"	699	466	460	460	460	460
Fuelwood:							
Consumption[5]	Million standard cords	58.6	26.9	22.0	20.0	18.0	16.5
Net imports	"	--[4]	--[4]	--	--	--	--
Domestic production	"	58.6	26.9	22.0	20.0	18.0	16.5
Domestic roundwood	"	27.2	15.0	13.2	12.0	10.8	9.8

[1] The difference between domestic production of lumber and domestic roundwood production (saw logs) in 1962 and later years largely reflects the growing practice of converting to pulp chips a portion of the lower-grade material in saw logs. The 1952 estimate was based on a special Forest Survice survey of log and lumber production.
[2] Including equivalent log volumes of imported veneer and plywood.
[3] Including equivalent log volumes of imported pulp and paper and board, plus plant byproducts.
[4] Less than minimum reporting unit.
[5] Including equivalent log volumes of plant byproducts.

APPENDIX B

DEFINITION OF TERMS

APPENDIX B

DEFINITION OF TERMS

Allowable Cut—The volume of timber that may be cut during a given period under specified management plans for sustained production, such as those in effect on National Forests.

Commercial Forest Land—Forest land which is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Includes areas suitable for management to grow crops of industrial wood generally capable of producing in excess of 25 cubic feet per acre of annual growth. Includes both accessible and prospectively accessible areas and both operable and prospectively operable areas.

Commercial Species—Tree species presently or prospectively suitable for industrial wood products; excludes so-called weed species, such as willow and dogwood.

Cull Trees—Live trees that do not contain at least one merchantable 12-foot saw log now or prospectively, because of defect, rot, or species (also see sound cull trees and rotten cull trees).

Diameter Classes—A classification of trees based on diameter of the tree outside bark, measured at breast height (4½ feet above the ground). D.b.h. is the common abbreviation for "diameter at breast height." Two-inch diameter classes in which the even inch is the approximate midpoint are used. For example, the 6-inch class includes trees 5.0 to 6.9 inches d.b.h. inclusive.

Employment—The number of workers reported under the appropriate SIC Codes by the Oregon Department of Employment. It includes only that employment covered by the State Unemployment Insurance Law.

Forest Land—Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover and not currently developed for nonforest use. (Also, see commercial forest land, noncommercial forest land, productive-reserved forest land, and unproductive forest land). Includes chaparral areas in the West and afforested areas. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas are classed as forest if less than 120 feet in width.

Forest Management—The protection and management of forest lands for the production of timber and related products.

Forest Trees—Woody plants having a well-developed stem and usually more than 12 feet in height, including both growing stock and cull trees.

Growing-Stock Trees—Live sawtimber trees, poletimber trees, saplings and seedlings meeting specified standards of quality or vigor; excludes cull trees.

Growth—See definitions for "net annual growth" and "ingrowth."

Hardwoods—Dicotyledonous trees, usually broad-leaved and deciduous.

Harvesting—The harvest and transportation of logs and related products from forests to local points of delivery.

Land Area—(a) Census definition: The area of dry land and land temporarily or partially covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres in area; (b) Forest Survey definition: Same as above except maximum width of streams, etc., is 120 feet and maximum size of lakes, etc., is 1 acre.

Mortality—The volume of sound wood in live sawtimber and poletimber trees dying from natural causes during a specified period.

National Forest Land—Federal lands which have been designated by Executive order or statute as National Forests or purchase units, and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Net Annual Growth—The annual change in volume of sound wood in live sawtimber and poletimber trees resulting from natural causes, i.e., increase in volume in absence of mortality and cutting, minus mortality, plus growth on mortality and

growth on one-half the cut during a specified year.

Net Volume—The gross volume of a tree less deductions for rot, sweep, or other defects affecting use.

Nonstocked Areas—Commercial forest land less than 10 percent stocked with growing-stock trees.

Ownership—The property owned by one owner, regardless of the number of parcels that it may consist of, in a specified area such as a State or the United States as a whole.

Plant Residues—Wood materials from primary manufacturing plants that are not used for some product.

Poletimber Stands—Stands at least 10 percent stocked with growing-stock trees, and with half or more of this stocking in sawtimber and/or poletimber trees, and with poletimber stocking exceeding that of sawtimber.

Poletimber Trees—Live trees 5.0 to 10.9 inches in diameter at breast height.

Productive-Reserved Forest Land—Productive public forest land withdrawn from timber utilization through statute or administrative regulation.

Projected Demand—The estimated quantity of a roundwood product, or products, that would be demanded at specified times in the future under explicit assumptions as to (1) the growth of population and national product, (2) trends in the use of materials, and (3) trends in the prices of timber products relative to substitute materials.

Projected Employment—The estimated volume of employment that would be associated with meeting projected demands for a timber product or products at specified times in the future under explicit assumptions as to (1) changes in productivity; i.e., output per employee, and (2) changes in secondary manufacturing activities.

Roundwood (Roundwood Products)—Logs, bolts, or other round sections cut from trees.

Saplings—Live trees of commercial species 1.0 inch to 5.0 inches in diameter at breast height and of good form and vigor.

Sawtimber Stands—Stands at least 10 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber or poletimber trees and with sawtimber stocking at least equal to poletimber stocking.

Sawtimber Trees—Live trees containing at least one minimum saw log. Softwoods must be at least 9.0 inches in diameter at breast height except in California, Oregon, Washington, and coastal Alaska, where the minimum diameter is 11.0 inches. Hardwoods must be at least 11.0 inches in diameter in all states.

Softwoods—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Standard Industrial Classification (SIC)—A classification of establishments by type of activity in which engaged. An "establishment" is an economic unit which produces goods or services.

Stocking—A measure of the degree to which area is occupied or utilized by trees of specified classes, including (1) all live trees, (2) growing-stock trees, and (3) desirable trees. Classification of forest land and forest types is based on stocking of all live trees. Stocking of growing-stock trees is used to determine stand size and age class. Area-condition classes are based on stocking of desirable trees.

Stocking Standards—The minimum number of well-spaced trees required to fully utilize the area by specified forest types and sites.

Timber Cut From Sawtimber—The net board-foot volume of live sawtimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Timber Products—Roundwood products and byproducts of primary wood manufacturing plants. Includes saw logs, veneer logs and bolts, cooperage logs and bolts, pulpwood, fuelwood, piling, poles, posts, hewn ties, mine timbers, and other round, split, or hewn products.

Timber Products Industries—Industries included in Major Group 24, Lumber and Wood Products, Except Furniture; and Major Group 26, Paper and Allied Products, described in the Standard Industrial Classification Manual. The major industires are:

> **Logging**—Logging camps and logging contractors primarily engaged in cutting timber and in producing rough, round primary forest or wood raw materials.
>
> **Sawmills and Planing Mills**—Establishments primarily engaged in sawing rough lumber and timber from logs and bolts, or resawing cants and flitches into lumber, including box lumber, and softwood cut stock; planing mills combined with sawmills; and separately operated planing mills which are engaged primarily in producing surfaced lumber and standard workings or patterns lumber.
>
> **Veneer and Plywood Plants**—Establishments primarily engaged in producing commercial veneer, either face or technical, and

those primarily engaged in manufacturing commercial plywood, including nonwood backed or faced veneer and nonwood faced plywood, from veneer produced in the same establishment or from purchased veneer.

Paper and Allied Products—Establishments primarily engaged in the manufacturing of pulps from wood and other cellulose fibers and rags; the manufacture of paper and paperboard; and the manufacture of paper and paperboard into converted products such as paper coated off the paper machine, paper bags, paper boxes, and envelopes.

Miscellaneous Wood Manufacturing—Employment reported for several other SIC divisions within Major Group 24 were combined as miscellaneous wood manufacturing. The group includes hardwood dimension mills, shingle mills, millwork plants, prefabricated structures, wooden containers, and wood preserving. Industries in this group are either secondary manufacturers or they process a small amount of the total log harvest. They employ a relatively small proportion of the total number of workers.

Wood is consumed by firms in Major Group 25, Furniture and Fixtures, but these industries were not studied because the quantities of wood processed, often in combination with other materials, and number of workers employed in the Pacific Northwest are small.

Tree Size Classes—A classification of growing-stock trees according to diameter at breast height outside bark, including sawtimber trees, poletimber trees, saplings and seedlings.

Value Added by Manufacture—Adjusted value added is obtained by subtracting cost of materials, supplies and containers, fuel, purchased electric energy, and contract work from value of shipments for products manufactured, plus receipts for services rendered and other receipts such as the sale of scrap. It also includes (1) value added by merchandising operations (i.e., the difference between the sale value and cost of merchandise sold without further manufacture, processing, or assembly), plus (2) the net change in finished goods and work-in-process inventories between the beginning and end of the year (Bureau of Census 1958).

Volume of Growing Stock—The cubic-foot volume of sound wood in the bole of noncull sawtimber and poletimber trees of commercial species from a 1-foot stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

Volume of Sawtimber—Net volume of the saw-log portion of live sawtimber trees in board feet.

Young-Growth Sawtimber Stands—Sawtimber stands in which 50 percent or more of the stand is in young-growth sawtimber trees.

Young-Growth Sawtimber Trees—Trees that have not passed the age of physiological maturity.

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Exhibit C
Economic Aspects of the Mineral Industry

EXHIBIT C

ECONOMIC ASPECTS OF THE MINERAL INDUSTRY IN THE PUGET SOUND AND ADJACENT WATERS AREA

Prepared for
PUGET SOUND TASK FORCE of the PACIFIC NORTHWEST RIVER BASINS COMMISSION

By
William N. Hale and Gary A. Kingston
Bureau of Mines

U.S. DEPARTMENT OF THE INTERIOR

July 1966

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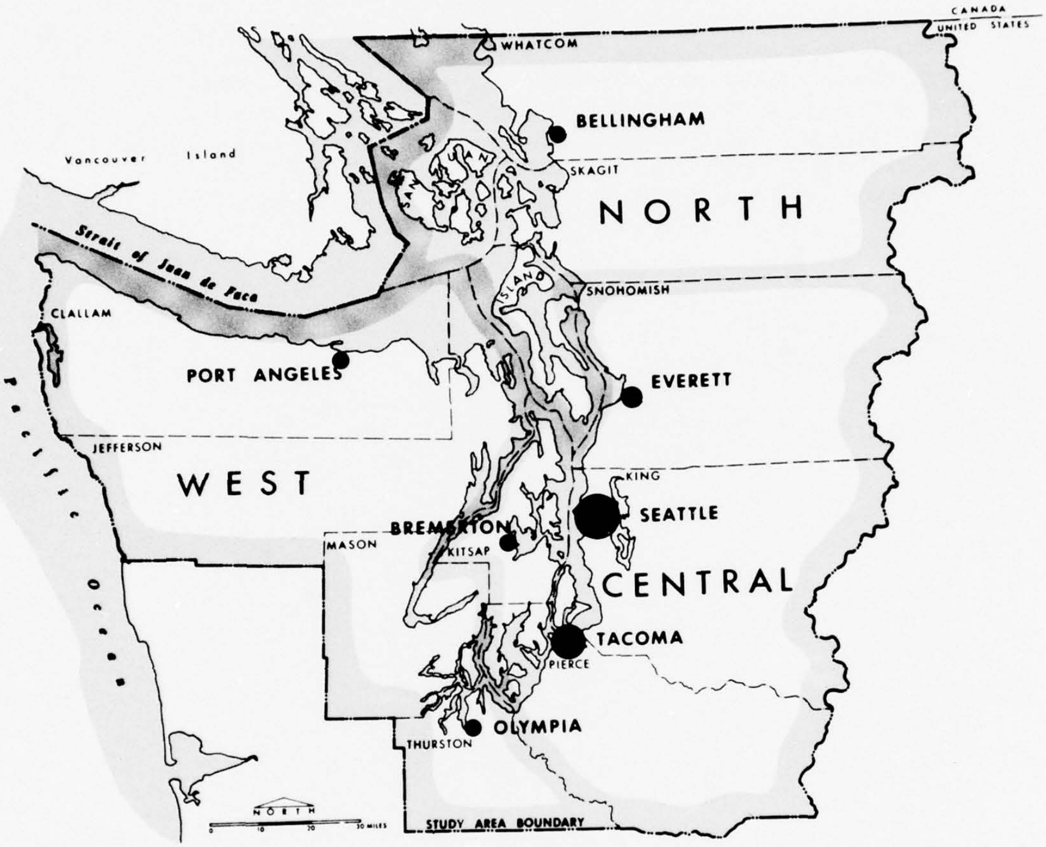

FIGURE 1. Study Area and Economic Divisions

INTRODUCTION

PURPOSE

The mineral industry study of the Puget Sound and Adjacent Waters Study Area is provided as an input to the regional economic studies committee of the Puget Sound and Adjacent Waters resource development program. In preliminary form, scheduled for July 1966, it will represent a source of information to other organizations for further evaluation, assessments, and planning with regard to water and land use as related to the minerals industry in the Area. In final form, scheduled for January 1967, it will serve as an appendix to a comprehensive water resource study being compiled by a consulting firm that will be responsible for an overall economic appraisal of the Puget Sound and Adjacent Waters Area. The survey is intended to furnish guidance for appraising the need for comprehensive development of water and related land resources as set forth by Senate Document 97.

SCOPE

The mineral study delimits the mineral industry potential of a 12-county area. The 12 counties covered are King, Kitsap, Island, Pierce, San Juan, Skagit, Snohomish, and Whatcom, and parts of Clallam, Jefferson, Mason, and Thurston. Further locational detail is provided by the distribution of the regional Puget Sound Area sector among three economic divisions; North, Central and West (Figure 1).

Major objectives are to present the record of mineral production, describe the type and location of major mineral resource deposits in the area, identify the economic and technologic influences on the mineral industry within the Area, and project the activity of the minerals industry within the study area for the years 1980, 2000 and 2020.

Since the future economy of the Puget Sound Area will not occur in geographic isolation, the study includes consideration of areas beyond the regional boundaries which influence economic development in the area of principal interest. The economic activity of the Puget Sound Area is tied to activities in the Pacific Northwest, the Nation, and other nations because of trading relations and competition. An analysis is made of these interrelationships and their trends and changes as they influence the economic future of the Puget Sound Area.

BASIC ASSUMPTIONS

The basic assumptions for this study are similar to those adopted by Bonneville Power Administration in its Economic Base Study of the Pacific Northwest. Some of the national assumptions used by the agency that pertain to this study are:

1. Sufficient quantities of water of acceptable quality will be available by timely development to avoid being a constraint to economic growth.
2. The Federal Government, as a matter of national policy, will actively support programs designed to stimulate economic growth.
3. There will be no general war or any appreciable cessation of the cold war throughout the period to 1980. Expenditures on national security will continue to account for approximately 10% of GNP. After 1980, gradual disarmament will decrease the relative cost of military expenditure.
4. There will be a continued relaxation of trade tariffs and quotas accompanied by an expansion in international commerce.
5. United States population will expand to:

1980	259,584,000
2000	336,800,000
2020	467,700,000

6. The Federal Government will use its resources energeticlly to promote maximum employment, production, and purchasing power; accordingly, employment at approximately 96% of civilian labor force will prevail nationally throughout the forecast period.
7. United States gross national product will increase in billions of 1960 dollars to:

1980	$1,130
2000	2,472
2020	5,402

8. Development of technological processes,

together with expansion of worker skills and capital formation, will increase productivity per manhour approximately 2.9% per year.

PHYSICAL FEATURES AND THEIR RELATIONSHIP TO MINING

The Puget Sound Area extends east about 110 miles from the Olympic Mountains to the Cascade Mountains divide, and south approximately 140 miles from the Canadian border to the southern tip. It falls within the Puget Sound and Cascade Mountain physiographic provinces in western Washington. The land area, of about 13,300 square miles, is slightly larger than the states of Delaware and Maryland combined; water area totals about 2,000 square miles. The west slopes of the Cascade Mountains cover the eastern part, and the east slopes of the Olympic Mountains cover the western portion. Lowlands are prominent in the central part from the southern tip to the Canadian border.

Puget Sound itself is an inland sea which joins the Pacific Ocean through the Strait of Juan de Fuca. The Sound, over 90 miles long, extends southward to Olympia. There are over 2,000 miles of coastline in the many inlets and islands of the Sound.

Puget Sound Province

The Puget Sound province lies between the Olympic Mountain-Willapa Hills area to the west and the Cascade Range to the east. It consists of a depressed area, mostly below 1,000 feet in altitude, that reaches across the State from Canada into Oregon, where the Willamette Valley is its geomorphic continuation. The northern half is partly occupied by the intricate reaches of Puget Sound, Admiralty Inlet, and the Georgia, Juan de Fuca, Rosario, and Haro Straits.

Rainfall is moderate, varying from 28 to 55 inches annually in areas of greatest population. There are many streams; most of the large rivers have their sources in the Cascade Range. The larger rivers, flowing into the Sound, have silted estuaries which form rich farm land; intermediate stages of the rivers contain marshes. A specific example is the Skykomish and Snoqualmie Rivers which have built up long fills that converge at Monroe (Snohomish County) where both rivers, forming a broad flat valley, continue as the Snohomish River to Puget Sound at Everett.

Throughout the Puget Sound Province, the bedrock consists largely of Tertiary sedimentary and volcanic rocks. Much of the southern part of the province is covered by sand and gravel and finer sediments that were sluiced out toward the south by melting glaciers. Alluvium also is common in areas immediately surrounding the Sound. In the northern half of the region, erosion has cut through the sedimentary formations exposing Paleozoic and Mesozoic rocks. The province is a region principally of industrial minerals; some metals have been mined in areas where pre-Tertiary formations are exposed.

Bituminous and subbituminous coal of the Eocene Puget group occurs extensively within the eastern part of the province. Of the eight major coal fields of the State, all but one are in this general area.

Cascade Mountain Province

The many large rivers and their tributaries have dissected the Cascade Mountains Province into deep valleys, canyons, and ravines. The intervening ridges are commonly steep-sided, high, and serrated above the timber line. Glacial features are common in the Cascade Mountain Range.

The rocks in the northern half of the Cascade Mountains Province are chiefly Paleozoic and Mesozoic sediments, and etamorphic types and intrusive granitic rocks. In the southern part, rocks are mainly younger (Tertiary) sedimentary types and volcanics.

CLIMATE

Average rainfall in the Puget Sound Area is 35 inches annually. Eighty percent of the rain falls in the winter months. Snowfall in western Washington is largely in the high mountain areas. Precipitation on the west slopes of the Cascade Range is high, averaging over 144 inches annually at Snoqualmie Pass, Mt. Baker, and Mt. Rainier. Permanent snow fields cover many of the places of higher elevation on the west slopes of the Cascade Range. Glaciers are common in favorable situations, such as the north slopes of many high ridges. The annual average snowfall at Mt. Baker Lodge is 41 feet, and at Paradise Inn on Mt. Rainier, nearly 50 feet. Mt. Rainier, with 27 named glaciers, has the most extensive glacier system of any peak in the United States, outside of Alaska.

TRANSPORTATION

Air

The Seattle-Tacoma International Airport, approximately midway between the two cities and served by major domestic airlines, is the largest for both passenger and cargo services. A wide variety of airfreight and specialized cargo services as well as charters are available. Arlington, Bremerton, Everett, Mt. Vernon, Olympia, and other communities are served locally by a number of smaller airfields.

Highways

Modern freeways, highways, and roads serve the Puget Sound Area. The principal north-south arterial freeway is Interstate 5 (U.S. Route 99). Federal highways cross the Cascade Mountains at Stevens Pass (U.S. No. 2), elevation 4,061 feet; Snoqualmie Pass (Interstate 90 or U.S. No. 10), elevation 3,004 feet; and Chinook Pass (U.S. No. 410), elevation 5,440 feet. State and county highways lead to the following glacier-clad-volcanic peaks of the Cascade Range: Mt. Baker, elevation 10,750 feet; Mt. Shuksan, 9,038 feet; and Mt. Rainier, 14,408 feet. Glacier Peak, at elevation 10,436 feet, is not accessible by road.

Railroads

Most communities of the Puget Sound Area receive direct and branch line railroad service. Four Class I transcontinental railroads serve the Puget Sound Area with trunk line and branch trackage and associated facilities. The four are: The Northern Pacific Railway Co., Great Northern Railway Co., Union Pacific Railroad Co., and the Chicago, Milwaukee, St. Paul, and Pacific Railroad Co. Transcontinental routes for three of the companies emerge from the Seattle metropolitan area eastward across the Cascade Range for service to the East. The fourth, Union Pacific Railroad Co., interconnects at Portland, Oregon, for its transcontinental services along the south bank of the Columbia River. In the Upper Puget Sound Area, the Great Northern and Northern Pacific Railways provide trackage interconnecting the Seattle-Tacoma metropolitan areas with Vancouver, British Columbia.

Water

The tidal waters of Puget Sound provide good harbors for deep-draft and shallow-draft water transportation. The 2,000 square miles of nearly landlocked salt water has 10 major ports having deepwater access to the Pacific Ocean. Principal ports are at Seattle and Tacoma, and others at Bellingham, Everett, and Bremerton have shoreside facilities for cargo handling, storage, and efficient handling of barge cargoes. Tug-barge operating systems are developed for Puget Sound service to Alaska and west coast points.

Ports of varying degrees of development, largely for handling specific cargoes for the pulp and paper and petroleum industries, are found at Anacortes, Olympia, Port Angeles, Port Townsend, and Shelton. There also are facilities at numerous other points for handling specialized products, such as at the Ferndale refinery, near Bellingham, for handling petroleum products. Similar facilities exist in the Anacortes area and in Snohomish County.

POPULATION

In 1960, total population of the Puget Sound Area was about 1.8 million people, or 62% of the total State population, concentrated in a densely settled urban land and in river basins along the eastern shores of Puget Sound and adjoining waters. The land area is about 13,300 square miles, or about 20% of the state total land area of 66,700 square miles. Population of the Area is expected to increase to 2.8 million people by 1980 and to over 7 million by 2020, Table 1.

For the minerals study, the Puget Sound Area can be subdivided into three economic subareas on the basis of population and general location. Distribution of population in 1960 by subarea was 86% in the central subarea (King, Kitsap, Pierce, and Snohomish Counties); 8% in the northern subarea (Whatcom, Skagit, Island, and San Juan Counties); and about 6% in the western subarea (Thurston, Mason, Jefferson, and Clallam Counties).

TABLE 1. Puget Sound Area land area and population trends and forecasts by subarea and county, 1940-2020[1]

Subarea & County	Land Area (Square Miles)	Population 1940	1950	1960	1980[2]	2000[2]	2020[2]
I. Central							
King	2,134	504,980	732,992	935,014	1,469	2,300	3,700
Kitsap	402	44,387	75,724	84,176	116	160	220
Pierce	1,676	182,081	275,876	321,590	502	760	1,150
Snohomish	2,100	88,754	111,580	172,199	337	630	1,200
Central Total	6,312	820,202	1,196,172	1,512,979	2,424	3,850	6,270
II. North							
Island	206	6,098	11,079	19,638	40	78	150
San Juan	172	3,157	3,245	2,872	3	4	5
Skagit	1,735	37,650	43,273	51,350	74	110	155
Whatcom	2,151	60,355	66,733	70,317	93	125	170
North Total	4,264	107,260	124,330	144,177	210	317	480
III. West							
Clallam	600[3]	21,848	26,396	30,022	42	60	83
Jefferson	700[3]	8,918	11,618	9,639	12	17	22
Mason	800[3]	11,603	15,022	16,251	22	33	45
Thurston	600[3]	37,285	44,884	55,049	84	125	185
West Total	2,700	79,654	97,920	110,361	160	235	335
Puget Sound Area Total	13,276	1,007,116	1,418,422	1,768,117	2,794	4,402	7,085
State Total	66,709	1,736,191	2,378,963	2,853,214	4,400	6,700	10,000
Percent of State Total	20%	58%	60%	62%	64%	66%	71%

[1] Washington State Census Board, Washington State Department of Planning and Economic Development, State Planning Series No. 4, Population Forecasts, State of Washington, 1965 to 1985. 1966, 89 pp. Projected data, computed independently for each county, were rounded to nearest thousand and extended by straight line from 1985 to 2020.

[2] Thousands.

[3] Land area, rounded to nearest 100 square miles, includes only parts of counties within the Area.

HISTORY OF MINING ACTIVITY

MINERAL PRODUCTION TRENDS

Mineral production values for the Puget Sound Area have ranged from \$23.9 million in 1955 to \$35.9 million in 1964, which is less than 1% of national mineral production values, Table 2.

TABLE 2. Value of mineral production by county, 1955, 1960, 1964 (thousand dollars)

County	1955	1960	1964	Minerals Produced in 1964, in Order of Value
Clallam	$ 253	$ 88	$ 231	Sand and gravel, stone.
Island	109	220	72	Stone, sand and gravel
Jefferson	W	457	W	do.
King	9,151	7,805	12,826	Cement, sand and gravel, stone, coal clays, peat.
Kitsap	133	282	372	Sand and gravel, stone, peat.
Mason	W	W	234	Stone, sand and gravel.
Pierce	2,502	3,290	4,327	Sand and gravel, lime, stone, clays, peat.
San Juan	W	156	W	Sand and gravel, stone.
Skagit	W	3,053	4,108	Cement, Olivine, sand and gravel, stone, soapstone, peat.
Snohomish	1,359	1,938	3,358	Sand and gravel, stone, peat, clays.
Thurston	387	267	347	Sand and gravel, coal, stone, peat.
Whatcom	W	W	W	Cement, stone, sand and gravel, olivine, clays.
Combined counties	10,034	W	9,676	
Total	23,928	W	35,551	
State Total	67,334	72,404	80,977	
% of State Total	36%	W	44%	
National Total (million dollars)	15,792	18,032	20,472	

W Withheld to avoid disclosing individual company data.

Although total mineral production values for the Area cannot be published each year, to avoid disclosing individual company confidential information, the area in the past decade has accounted for between 36 and 44% of the mineral production value in the State. The Puget Sound Area accounted for about 44% of the State mineral production value in 1964. Throughout the period 1955-64, five counties have led in terms of mineral production value. The counties, in order of descending value, are King, Whatcom, Pierce, Skagit, and Snohomish. On the average, mineral production value from the other seven counties amounts to less than $500,000 for each county annually and is confined largely to output of common construction materials, such as sand and gravel and stone.

Recorded mineral production for the Puget Sound Area approximates $741 million, Table 3. Although Bureau of Mines records for metals, coal, and cement are complete from early 1900, information before 1933 is sparse for the other nonmetals. Nevertheless, nonmetals have accounted for $527.6 million, or 70% of the total recorded mineral production value. Coal and peat, at $216.4 million, comprised 29% of the total, and metals, at $7 million, were less than 1% of the total recorded value.

Cement, coal, sand and gravel, and stone stand out as dominant materials produced and comprise over 96% of the total recorded mineral production values in the Area.

Several commodities, such as clay, lime, silica sands, olivine, talc, copper, gold and manganese, have contributed significantly to the total minerals value and will possibly share in the future economic contributions to the area.

TABLE 3. Mineral production in Puget Sound Area, 1900-64

	Quantity[1] (Thousands)	Value (Thousands)	Counties Produced In	Years of Recorded Production
Nonmetals				
Abrasives	W	W	Pierce, Skagit	1923-43, 1946-47
Asbestos	W	W	Skagit	1930-34
Clay	2,501	$ 2,897	King, Pierce, Skagit, Snohomish, Whatcom	1933-64
Cement (376-lb. barrels)	127,230	319,319	King, Skagit, Whatcom	1909-64
Lime	597	8,791	King, Pierce, San Juan, Snohomish, Whatcom	1925-56, 1963-64
Olivine	W	W	Skagit, Whatcom	1946-64
Pumice	1	2	King, Skagit, Snohomish	1946-52, 1955-56
Sand and gravel	161,275	118,182	All counties	1935-64
Silica sand	492	2,864	King, Pierce, Skagit, Whatcom	1937-64
Stone	45,909	71,935	All counties	1929, 1933, 1937-64
Strontium	W	W	Skagit	1940-42, 1946, 1953, 1956-59
Sulfur	*2	9	King	1939-40, 1943-47, 1950
Talc	93	601	King, Skagit	1933-64
Undistributed[3]	109	3,031		
Total nonmetals[4]		$527,629		
Fuels				
Coal	69,260	214,912	King, Pierce, Skagit, Thurston, Whatcom	1900-64
Peat	306	1,522	King, Kitsap, Pierce, Skagit, Snohomish, Thurston	1957-64
Total fuels[4]		$216,434		
Metals[5]				
Gold (ounces)	107	2,689	Clallam, King, Pierce, Skagit, Snohomish, Whatcom	1904-64
Silver (ounces)	343	230	Clallam, King, Pierce, Skagit, Snohomish, Whatcom	1904-49, 1951-62
Copper	7	2,252	King, Pierce, Skagit, Snohomish, Whatcom	1904-11, 1914-30, 1933-49, 1951-56, 1958-62
Lead-zinc	*2	3	King, Pierce, Skagit, Snohomish, Whatcom	1908, 1910, 1914, 1916, 1918, 1922, 1924-41, 1949, 1951-53, 1961
Chromite	*2	10	Skagit	1917-18, 1956, 1958-59
Iron ore	35	W	Snohomish	1907-10
Manganese (35% or more Mn)	52	1,845	Clallam, Mason	1916, 1924-26, 1942-46, 1952-53, 1959
Mercury	W	W	King	1957-58
Molybdenum	3	W	Snohomish	1958-59
Undistributed[6]		67		
Total metals[4]		$ 7,095		
Mineral industry total[4]		$751,159		

W Figure withheld to avoid disclosing individual company confidential data.

1 Short tons unless otherwise specified.

2 Less than 500 tons.

3 Value of nonmetal items that cannot be disclosed: abrasives, asbestos, olivine, strontium.

4 Figures in columns may not add to total because of rounding.

5 Recoverable content of ores, etc.

6 Value of metal items that cannot be disclosed: iron ore, mercury, and molybdenum.

Compiling production of minerals by decade shows that construction materials, such as cement, sand and gravel, and stone, are increasing in output, Table 4. Progressive increases also show for lime, olivine, and silica. Output of clays and talc has declined from the 1950-59 base, and coal output shows a continuous decline from the high rates of production established during the period 1910-19.

For metals, production of gold was highest during the depression years, copper was mined extensively in the late 1920's, and manganese output was greatest during World War II.

TABLE 4. Production of minerals in Puget Sound Area by decade[1]

	Nonmetals													
	Cement		Sand & Gravel		Stone		Clay		Silica		Talc		Undistributed[2]	
Year	Barrels	Value	Short Tons	Value	Short Tons	Value	Short Tons	Value	Short Tons	Value	Short Tons	Value	Short Tons	Value
1900-09	519	$ 886	--	--	--	--	--	--	--	--	--	--	--	--
1910-19	9,417	15,404	--	--	--	--	--	--	--	--	--	--	--	--
1920-29	17,244	37,208	--	--	28	$ 70	--	--	--	--	--	--	98	$ 1,369
1930-39	19,656	32,295	6,728	$ 2,921	1,419	2,049	82	$ 99	--	--	2	$ 15	149	1,678
1940-49	27,966	60,881	29,958	15,728	6,628	9,705	570	606	119	$ 419	24	203	173	2,391
1950-59	33,035	104,164	71,894	53,227	22,386	36,120	1,309	1,578	209	1,237	52	300	119	2,455
1960-64	19,393	68,482	52,695	46,306	15,448	23,991	540	614	163	1,208	14	82	167	3,938
Total[3]	127,230	319,319	161,275	118,182	45,909	71,935	2,501	2,897	492	2,864	93	601	706	11,831

		Fuels					Metals							Mineral Industry
	Nonmetals Total	Coal		Peat		Fuels Total	Gold		Silver		Copper, Lead, Zinc	Other Metals	Metals Total	Total
Year	Value	Short Tons	Value	Short Tons	Value	Value	Ounces	Value	Ounces	Value	Value	Value	Value	Value
1900-09	$ 886	17,148	$ 34,023	--	--	$ 34,023	22	$ 458	120	$ 72	$ 66	$ 52	$ 648	$ 35,557
1910-19	15,404	19,276	49,824	--	--	49,824	19	395	41	33	349	15	793	66,020
1920-29	38,647	14,061	52,359	--	--	52,359	26	542	115	80	1,347	320	2,288	93,294
1930-39	39,058	9,773	29,985	--	--	29,985	37	1,213	27	15	219	--	1,447	70,490
1940-49	89,932	6,786	32,366	--	--	32,366	1	51	33	23	106	1,418	1,598	123,897
1950-59	199,082	1,895	13,592	107	$ 393	13,985	1	22	7	6	130	117	274	213,340
1960-64	144,621	322	2,763	199	1,130	3,892	[4]	8	1	1	38	--	47	148,561
Total[3]	527,629	69,260	214,912	306	1,522	216,434	107	2,689	343	230	2,255	1,921	7,095	751,159

1 Quantities and values are thousands.

2 Includes abrasives, asbestos, lime, olivine, strontium, sulfur.

3 Columns and rows may not add to totals because of rounding.

4 Less than 500.

TABLE 5. Relative unit values of nonmetals and coal from Puget Sound Area by decade, 1900-64[1]

Year	Spencer Raw Material[2] Price Index 1957-59 = 100	*Construction Materials*					
		Cement		Sand & Gravel		Stone	
		Actual[3]	Relative[4]	Actual[3]	Relative[4]	Actual[3]	Relative[4]
1900-09	34.1	$1.71	$5.00				
1910-19	40.8	1.64	4.00				
1920-29	69.2	2.16	3.12			$2.50	$3.62
1930-39	52.6	1.64	3.12	$0.43	$0.82	1.44	2.74
1940-49	65.4	2.18	3.33	.53	.81	1.46	2.23
1950-59	93.0	3.15	3.38	.74	.80	1.61	1.73
1960-64	101.0	3.53	3.50	.88	.87	1.55	1.53

		Other Nonmetals							
		Clay		Silica		Talc		Undistributed	
		Actual[3]	Relative[4]	Actual[3]	Relative[4]	Actual[3]	Relative[4]	Actual[3]	Relative[4]
1900-09	36.1								
1910-19	46.3								
1920-29	46.2							$13.97	$30.20
1930-39	27.3	$1.21	$4.43			$7.50	$27.50	11.26	41.20
1940-49	47.5	1.06	2.23	$3.52	$7.40	8.46	17.80	13.82	29.10
1950-59	87.8	1.21	1.38	5.92	6.75	5.77	6.57	20.63	23.50
1960-64	109.0	1.14	1.05	7.41	6.80	5.86	5.38	23.58	21.60

		Fuels	
		Coal	
		Actual[3]	Relative[4]
1900-09	20.7	$1.98	$9.55
1910-19	29.3	2.58	8.80
1920-29	49.6	3.72	7.50
1930-39	33.1	3.07	9.26
1940-49	66.8	4.77	7.14
1950-59	98.4	7.17	7.30
1960-64	94.0	8.58	9.10

1 Values for cement are dollars per barrel; other commodity values are dollars per ton.

2 U.S. Department of Commerce. Raw Materials in the United States Economy: 1900-1961.

3 Average price for period.

4 Period average price adjusted by price index.

Relative unit values of minerals over the period 1900-64 were computed by dividing actual unit values of select commodities by the Spencer raw material price index (31),[3] Table 5. Annual raw material prices were aggregated to conform to decade compilations derived from Table 4. The computations of average price adjusted by the price of index show that the relative price for many of the nonmetals, such as stone, clay, silica, talc, lime, and olivine, have declined in the past 25 years.

Throughout the 25-year period, the relative unit price for cement increased only by 17 cents per barrel, and sand and gravel increased only 6 cents per ton. Coal, in direct contrast to these figures, has increased about $2.00 per ton over the 25-year period.

MINERAL COMMODITY REVIEWS

Reviews by commodity are given for minerals ascertained from past relationships to be important to the growth of the Area. Past and current trends are given for each commodity where information is available. Relationships such as marketing factors (local, national and regional), technology, specifications, processing techniques, substitution, trends in ore grade, and other important aspects for many commodities are discussed. Much of the background information and statistics regarding minerals are taken from Bureau of Mines files and from publications giving regional and general trends and comprehensive information about minerals. (32) (33) Pertinent information also is given for mineral requirements by the pulp and paper and primary metals industries. The major mineral industry producers and related industrial operations in the Puget Sound Area are shown by economic division in Figure 2. Current plant expansions also are given on the map. Sand and gravel and common stone operations producing less than 100,000 tons annually are excluded.

NONMETALS

Cement

In the Puget Sound Area, cement is produced by Lone Star Cement Company at Concrete and Seattle, by Columbia Cement Company (formerly Kaiser Cement & Gypsum Corp.) at Bellingham, and by Ideal Cement Company at Grotto. There are two other cement plants in the State, one in Pend Oreille County and one in Spokane County.

Cement production began in the Basin at the Concrete plant in 1909; output followed at Bellingham in 1913, at Grotto in 1928, and at Seattle in 1929.

Cement data for the State of Washington have been combined with Oregon figures in the past to avoid disclosing information concerning Oregon producers; therefore, past production data cannot be given for the State of Washington. Production of cement from the four plants in the Area can be shown historically without revealing individual plant data in Oregon and Washington, and production figures for the four plants in the Area are shown in Table 6.

TABLE 6. Production of cement in the Puget Sound Area, 1950-64

Year	Quantity (376-Pound Barrels)	Value
1930	2,823,354	
1940	2,879,096	
1950	3,223,513	$ 8,559,812
1951	3,584,928	10,570,367
1952	3,543,539	10,512,001
1953	3,475,647	10,556,458
1954	3,192,020	10,131,710
1955	3,783,517	12,007,528
1956	3,017,280	10,454,982
1957	2,240,301	7,659,128
1958	3,196,136	11,023,906
1959	3,778,502	12,688,124
1960	3,815,359	13,305,679
1961	3,698,237	12,675,111
1962	3,676,688	13,064,249
1963	3,819,533	13,716,593
1964	4,291,717	15,721,047

Commitments were made in 1965 by three firms to construct additional cement-producing facilities in the Puget Sound Area. Peter Kiewit Sons' Co. was named general contractor for constructing Ideal Cement Company's proposed $20 million cement plant at Seattle. Foundation testing and other work are underway at the company's 25-acre site on the Duwamish River Waterway, and completion of the 2.5 million-barrel-annual capacity plant is scheduled for 1967. The source of limestone for the operation

[3] Underlined numbers in parentheses refer to items in the list of references at the end of the report.

MINERAL PROCESSING AND RELATED INDUSTRIAL OPERATIONS—1964

Cement

1 Kaiser Cement & Gypsum Corp.
2 Lone Star Cement Corp.
3 Lone Star Cement Corp.
4 Lone Star Cement Corp.
5 Ideal Cement Co.
6 Kaiser Cement & Gypsum Corp.
7 Ideal Cement Co.

Lime

8 Pacific Lime, Inc.

Aluminum

9 Kaiser Aluminum & Chem. Corp.
10 Intalco Aluminum Corp.

Copper (& byproduct sulfuric acid)

11 American Smelting & Refining Corp.

Ferroalloys

12 Ohio Ferroalloys Corp.

Steel

13 Bethlehem Steel Co., Pac. Coast Div.
14 Northwest Steel Rolling Mills, Inc.
15 Isaacson Iron Works

Petroleum

16 Mobil Oil Co., Inc.
17 Shell Oil Co.
18 Texaco, Inc.
19 Union Oil Co. of California
20 U.S. Oil & Refining Co.

Sulfuric acid

21 General Chem. Div., Allied Chem. Corp.

Chlorine

22 Georgia Pacific Corp.
23 Hooker Chem. Corp.
24 Pennsalt Chemicals Corp.

Glass

25 Northwestern Glass Co.

Gypsum

26 Kaiser Cement & Gypsum Corp.

Clays

27 Builders Brick Co.
28 Builders Brick Co.
29 Builders Brick Co.
30 International Pipe & Ceramic Corp.
31 International Pipe & Ceramic Corp.
32 International Pipe & Ceramic Corp.
33 International Pipe & Ceramic Corp.
34 International Pipe & Ceramic Corp.
35 Lowell Brick & Tile Co.
36 Lynden Clay Products, Inc.

Coal

37 Coal, Inc.
38 Palmer Coking Coal, Inc.
39 Palmer Coking Coal, Inc.
40 Queen Coal Co.

Olivine

41 Northwest Olivine Corp.
42 Olivine Corp.

Silica

43 Smith Bros. Silica Sand., Inc.
44 Cavanaugh Molding Sand Co.

Talc and miscellaneous

45 Northwest Talc & Magnesium
46 Manufacturers Mineral Co.

Sand & gravel, 100,000-200,000 tons

47 Miles Co.
48 North Kitsap Gravel & Asphalt Co.
49 Olympia Oil & Wood Products Co.
50 Reid Sand & Gravel, Inc.
51 Stoneway Sand & Gravel Co.
52 Tim Corliss & Sons
53 Western Sand & Gravel Co.

200,000-500,000 tons

54 Associated Sand & Gravel Co., Inc.
55 Cadman Gravel Co.
56 Cascade Asphalt Paving Co.
57 Freeway Concrete Supply Co.
58 Holroyd Land Co., Inc.
59 Lakeside Gravel Co.
60 North Star Sand & Gravel Co.
61 Renton Sand & Gravel
62 Renton Sand & Gravel

Over 500,000 tons

63 Boise Cascade Corp., Klinker Div.
64 Friday Harbor Sand & GravelCo.
65 Glacier Sand & Gravel Co.
66 Pioneer Sand & Gravel Co.

Stone, 100,000-200,000 tons

67 Associated Sand & Gravel Co., Inc.
68 Black River Quarry, Inc.
69 Woodworth & Co., Inc.

200,000-500,000 tons

70 Associated Sand & Gravel Co., Inc.
71 General Construction Co.
72 Kaiser Cement & Gypsum Corp.
73 Lone Star Cement Corp.
74 Puget Sound Bridge & Dry Dock Co.

Numbers refer to Figure 2

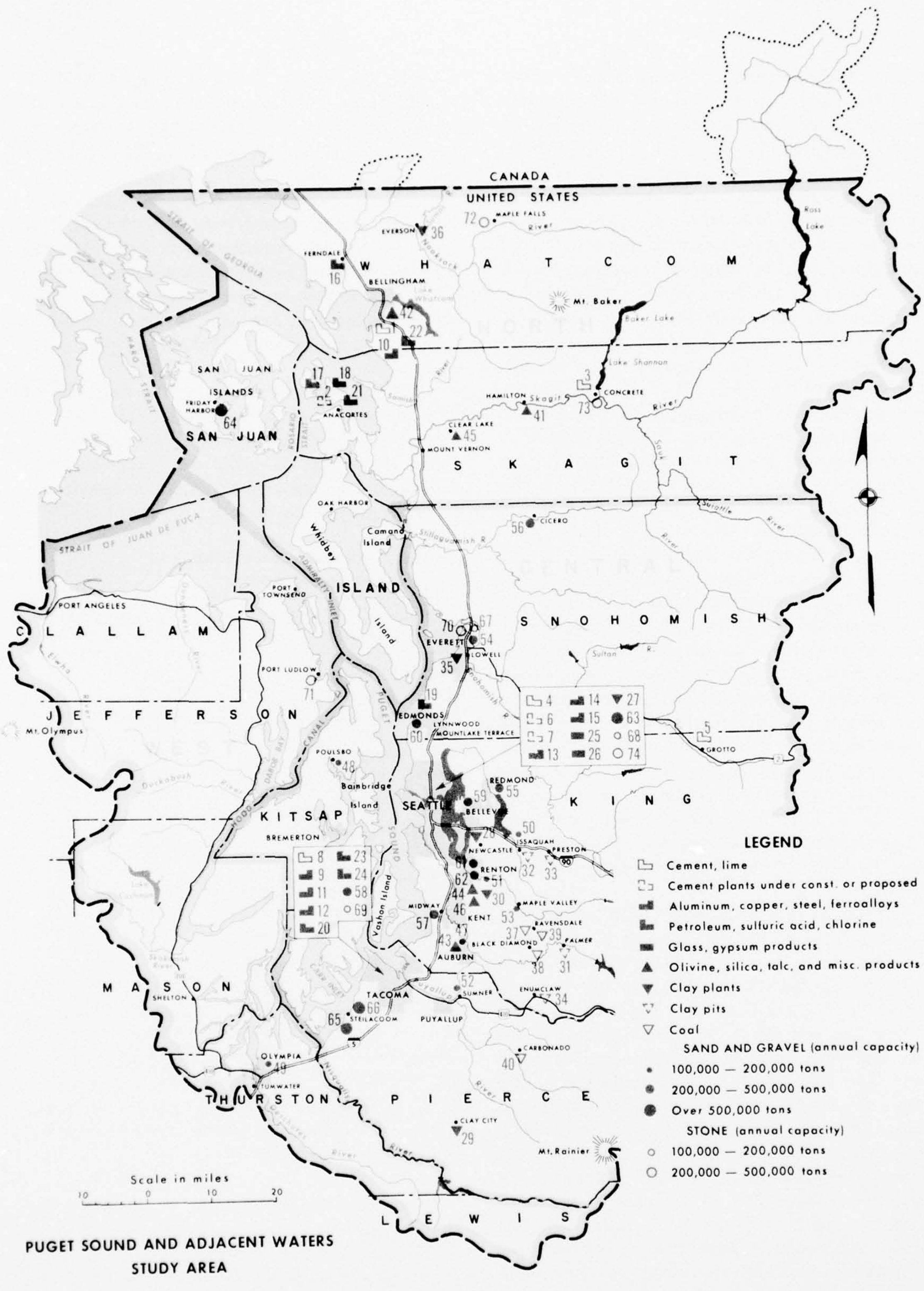

FIGURE 2. Mineral processing and related industrial operations, 1964

will be from deposits at Texada Island, British Columbia. Kaiser Cement & Gypsum Corporation announced settlement agreement with the Federal Trade Commission providing for divestment of its cement plant at Bellingham and two of the three aggregate and ready-mix cement plants of its subsidiary, Glacier Sand & Gravel Company. The aggreement provided that the cement plant be divested within 4 years and the two aggregate and ready-mix concrete plants within 2 years. The company cement plant at Bellingham was sold to Pittsburgh Plate Glass Company (Columbia Cement Company, a subsidiary, is operator) in 1966. The aggregate and ready-mix concrete plants of Glacier Sand and Gravel Company to be divested were the Vancouver, Washington, plant and the Albina Street plant in Portland, Oregon. To protect its market position in the area, Kaiser Cement & Gypsum Corporation signed a long-term lease with the Seattle Port Commission for a proposed 20-acre tidewater cement-plant site on the Duwamish River Waterway at Seattle. The company did not set a date for the proposed 2-million-barrel-annual-capacity cement plant construction; however, terms of the lease require the company to make property improvements of at least $10 million within four years. The firm is expected to use high-calcium limestone from Texada Island, British Columbia. Late in 1965, Lone Star Cement Company announced that it held options on several sites and was in the final stages of preparation for an additional cement-producing facility, with potential of producing 4 million barrels annually. If a site at Anacortes is selected for this operation, the firm tentatively plans to obtain limestone by pipeline from its Concrete quarry in Skagit County.

Cement firms operate distribution centers, including storage silos for bulk cement to service local markets; some large users, such as ready-mixed concrete companies, have similar storage facilities. Cement is distributed to consumers in the Puget Sound Area and the State of Washington and surrounding areas from the four operating plants and from three distribution terminals. Ideal Cement Company operates a cement distribution plant at Seattle. Kaiser Cement & Gypsum Corporation operates two terminals at Seattle. It is estimated that in 1964 about 1 million barrels of cement produced in the Area was shipped out of the area to points of consumption within and outside the State. Shipments of Portland cement by Washington producers by type of customer in 1964 were 58.6% to ready-mixed concrete companies, 11.5% to concrete product manufacturers, 5.2% to building material dealers, 13.5% to highway contractors, 10.5% to other contractors and less than 1% to Federal, State, and local government agencies.

Cement consumption in the United States and Washington for select years from 1910-64 is shown in Table 7. Per capita consumption in Washington has been greater than United States per capita consumption, which is probably due to dam construction in the State; however, beginning in 1961, per capita consumption in the State fell below the United States figures.

Consumption of cement in the Puget Sound Area, shown in Table 8, was estimated from the State per capita figures. About 85% of the cement consumed in the Area is within the Central economic subarea, and an estimated 75% is used in manufacturing concrete products such as ready-mixed concrete.

TABLE 7.—Cement consumption. (thousand 376-pound barrels)[1]

Year	United States		Washington	
	Quantity	Per capita	Quantity	Per capita
1910	74,381	0.81	NA	NA
1920	94,001	0.86	1,834	1.33
1930	158,030	1.29	3,102	1.98
1940	127,701	0.96	3,541	2.04
1950	222,608	1.48	4,210	1.77
1951	235,047	1.53	4,518	1.86
1952	245,177	1.57	4,954	2.01
1953	255,263	1.61	5,399	2.17
1954	269,827	1.67	5,631	2.24
1955	287,135	1.74	5,595	2.15
1956	303,399	1.80	4,683	1.76
1957	283,912	1.67	5,088	1.87
1958	302,070	1.73	6,545	2.36
1959	331,263	1.87	5,721	2.03
1960	307,564	1.71	5,643	1.98
1961	351,715	1.92	5,462	1.85
1962	326,146	1.76	4,984	1.67
1963	343,061	1.82	5,224	1.71
1964	358,761	1.88	5,368	1.75

NA—Not available.

[1] Data are in terms of destination of shipments of finished portland cement from mills in the United States which is considered apparent consumption.

Raw materials consumed in manufacturing cement in the Puget Sound Area are shown in Table 9. The raw material requirements are based upon cement plant production capacity, which is estimated

to be 5.6 million barrels annually. During the past 15 years, cement plants in the Area have operated at between 54 and 77% of total capacity. The existing cement plants in the Area use large quantities of cement rock (argillaceous limestone), thereby reducing their clay and silica requirements. The two proposed plants near Seattle will probably use high-calcium limestone from Texada Island, British Columbia, and clay and silica requirements will be greater for these plants.

TABLE 8.—Estimated consumption of cement in Puget Sound Area.
(thousand 376-pound barrels)

Year	Economic Subarea Central	North	West	Puget Sound Area Total
1950	2,117	220	175	2,510
1960	2,995	285	220	3,500
1964	2,925	275	215	3,415

TABLE 9.—Estimated raw materials used in manufacturing cement in the Puget Sound Area, 1964.

	Existing plants Quantity[2]	Proposed plants[1] Quantity[2]
Cement rock (argillaceous limestone).	1,000	1,000
Limestone (high-calcium)	300	1,100[3]
Clay and siliceous materials	100	150
Slag	30	50
Gypsum	50	60
Energy (million kwhr)	125	200
Plant capacity (million barrels)	5.6	8.5

[1] Plants under construction and announced expansion.

[2] Thousand short tons unless otherwise specified.

[3] Assuming limestone (high-calcium) will come from Texada Island, British Columbia.

Transportation cost restrains the volume of imports and exports, limits the market area of the individual plant, and plays a major role in governing the movement of cement within an area and from one area to another. In 1964, 84% of the cement produced in the Area was transported by truck, 14% was shipped by rail, and 2% was moved by boat.

Originally, shipments of cement were in barrels to protect the product from exposure to moisture; however, the barrel has not been used as a container for many years. The traditional units of measure have been retained in showing cement statistics; bags containing one cubic foot of portland cement weigh 94 pounds, and four bags are equal to one 376-pound barrel. In 1964, over 88% of the shipments of cement in the Puget Sound Area was in bulk, and all the rest was in paper bags. Specially designed equipment is used to handle cement in bulk. Bulk transportation is by special trucks, railroad cars, ships, and barges which are self-unloading.

Labor costs have been reduced by use of higher capacity machinery combined with centralized controls with electronic or automatic equipment. The amount of labor required to manufacture a barrel of cement is estimated to range from 6 to 15 man-minutes, depending upon size and degree of automation of the plant. If employment costs are estimated at $3.50 per hour, then there is from 36 to 88 cents labor in producing a barrel of cement. Estimated labor cost for producing cement in the Puget Sound Area in 1964 was 62 cents per barrel.

The percentage increases in price for cement have lagged far behind competing building materials such as lumber. Total average value of cement produced in the Area by 10-year intervals has increased from $2.16 per barrel, f.o.b. plants, for the period, 1920-29, to $3.53 per barrel during the 5-year interval between 1960-64. When the value is compared in terms of constant 1957-59 dollars, the relative price has increased only $0.38 per barrel over a period of 45 years, or from $3.12 per barrel, f.o.b. plants, during the period 1920-29, to $3.50 per barrel during the period 1960-64.

It is illegal for cement companies to quote prices for their products at designated pricing points, but individual firms acting independently can absorb freight charges to compete in the available market.(9)

Portland cement has little utility alone but rather is the material which, in the presence of water, binds mineral aggregates into concrete, or as a constituent of mortar, will hold building blocks or bricks together. Most portland cements approach their ultimate strength in one year and reach 65 to 75% of their ultimate strength in 7 days. High-early-strength types reach almost one-half of their ultimate strength in one day. Cement is an essential constituent of concrete, and there is no substitute for cement in this field. As the binder in concrete for engineering construction, portland cement has comparatively little competition. For many concrete uses, the consumer has a choice of alternate materials

(bituminous concrete) or of using other materials such as pozzolan in combination with cement to lower the cement requirements. The choice of principal structural material is governed by many factors such as cost, personal preference, and building codes and specifications.

Specifications issued by the American Society for Testing Materials (ASTM) in 1917 were accepted as U.S. Government Standards. Since then, revisions have been made from time to time as various types of cement were produced to meet certain requirements. In 1940, the ASTM grouped portland cements under five types, based partly upon the proportions of calcium, silica, and alumina in the cement. The latest ASTM specifications are voluminous; the important specifications which have been determined are listed for each type of cement and may be obtained from the ASTM.

Clay

Clays are classified into six groups by the Bureau of Mines. These are kaolin, ball clay, fire clay, bentonite, fullers earth, and miscellaneous clay. Fire clay and miscellaneous clay are the only types produced in the Puget Sound Area. Fire clays are basically kaolinitic but usually include other clay minerals and both organic and inorganic compounds. Generally, fire clay indicates use for refractories.

The term miscellaneous clay refers to clay and shales not included under the other five clay types. There are no recognized grades based on preparation, and very little based on usage, although such clay may sometimes be referred to as common, brick, sewer pipe, or tile clay.

The quantities of fire clay and miscellaneous clay produced in the Puget Sound Area cannot be revealed individually for many past years, because it would reveal individual company data. The information can be published separately for only three years during the past 17 years, or from the period 1948-64. Total production of clays in the Puget Sound Area is shown in Table 10.

Fire clays for refractories totaled 9% of total clay production in 1948, 35% of total clay output in 1954, and 28% of clay production in 1957. These clays were valued, f.o.b. mine, at $2.77 per ton in 1948; $2.55 per ton in 1954; and $2.53 per ton in 1957. Common clays produced for the years specified above totaled 75,722 tons in 1948, 68,379 tons in 1954, and 130,640 tons in 1957. The clays were valued at $0.75 per ton , f.o.b. mine, in 1948; $0.71 per ton in 1954; and $0.88 per ton in 1957.

Output of miscellaneous clay and fire clay in the Puget Sound Area in 1964 totaled 106,752 tons valued at $126,297. The bulk of the production was from King County; some was produced in Pierce, Snohomish, and Whatcom Counties.

In King County, the glacial clay that is widely

TABLE 10.–Clays produced in the Puget Sound Area, 1948-64.

	Miscellaneous (common)		Fire clay (refractory)		Total clays	
Year	Short tons	Value	Short tons	Value	Short tons	Value
1948	75,722	$56,398	7,186	$19,974	82,908	$76,372
1949	W	W	W	W	90,749	101,576
1950	W	W	W	W	78,967	77,846
1951	W	W	W	W	76,584	100,856
1952	W	W	W	W	131,973	146,712
1953	W	W	W	W	109,637	132,969
1954	68,379	48,322	36,845	93,910	105,224	142,232
1955	W	W	W	W	181,111	187,695
1956	W	W	W	W	143,387	189,299
1957	130,640	119,295	50,028	126,671	180,668	245,966
1958	W	W	W	W	154,814	174,546
1959	W	W	W	W	146,376	179,918
1960	W	W	W	W	128,247	145,850
1961	W	W	W	W	118,305	133,520
1962	W	W	W	W	80,787	90,840
1963	W	W	W	W	105,917	117,780
1964	W	W	W	W	106,752	126,297

W–Withheld to avoid disclosing individual company data.

distributed along the coast has been used for many years in making structural clay products. The better grades of clay and carbonaceous shales for making refractories at the Renton complex of International Pipe & Ceramics Corporation occur in southern King County.

The highest concentration of ceramic plants in the Pacific Northwest is in the vicinity of Seattle. Six manufacturing plants in the Seattle area produce structural clay products and refractories.

Many clay deposits are mined in central and southeastern King County by International Pipe & Ceramics Corporation and transported to the company clay-processing complex at Renton. The mining in recent years of the Blum, Harris, and Kummer clay deposits, all in King County, by International Pipe & Ceramics Corporation has been the most extensive local development of ceramic raw materials of refractory grade in the Puget Sound Area. Common clays for manufacturing brick and other structural clay products have been mined by the company from the Palmer, Renton, Preston, and many other pits in King County. Some of the more important properties of the Puget Sound Area are discussed below.

Reserves of 1,715 million tons are outlined at the Blum deposit; the iron oxide content of the material is high, averaging 8.9%. (16) Kaolinite is the principal clay mineral; boehmite and gibbsite also are present in the shale. The material is dug and hauled about 21 miles by truck for processing at the Renton plant of International Pipe & Ceramics Corporation.

At the Harris mine, a dark-gray carbonaceous shale is mined. Overburden is stripped, and the clay face is blasted and loaded by drum hoist and scraper. The material is hauled by truck about eight miles for processing at the Renton plant of International Pipe & Ceramics Corporation. Underground mining is contemplated for this property in the future; reserves are estimated to be adequate for 50 years' supply at current rates of production.

The Kummer property, mined intermittently by International Pipe & Ceramics Corporation, yields a high-quality carbonaceous clay. Underground mining of this superduty refractory clay is by room-and-pillar method. The clay is burned in piles on the surface to oxidize carbonaceous material, hauled by truck 18 miles to Renton, and calcined in a rotary kiln at the plant of International Pipe & Ceramics Corporation. Proved and inferred reserves are estimated to be adequate for 25 to 30 years' supply at current rates of output.

At the Auburn mine, operated intermittently by International Pipe & Ceramics Corporation, a low-heat-duty fire clay high in silica, feldspar, and mica is produced by open-pit methods and hauled by truck 20 miles to the Renton plant. Reserves, equally divided between proved and inferred classifications, are estimated to be over 300,000 tons.

At the Palmer mine near Palmer, operated intermittently by International Pipe & Ceramics Corporation, a siliceous sedimentary clay is dug and hauled 23 miles to the Renton plant for making structural clay products. Proved reserves are estimated to be 125,000 tons.

The Renton property is a thick bed of red-firing shale adjacent to the plant of International Pipe & Ceramics Corporation. The shale, ranging from dark-gray to brown and from plastic to sandy in consistency, is blasted from a 150-foot quarry face and loaded into trucks for hauling to storage. Reserves are estimated to be very large.

The semi-refractory clays of the Hammer Bluff formation near Kummer about 6 miles north of Enumclaw have been mined in the past by International Pipe & Ceramics Corporation. Also, an estimated 1.1 million tons of alunite-bearing volcanics ranging from 30% alunite down to 24% alunite is deposited on the slopes of White River Valley, 10 miles east of Enumclaw. Other King County deposits of refractory clays include the Kangley, Kanaskat, and Durham deposits.

The only other recent clay producer in King County, Builders Brick Company produces a red-firing plastic clay from the Newcastle deposit near Newcastle with proved reserves of 50,000 tons and inferred reserves of 100,000 tons. The material is used by the company in manufacturing structural clay products.

The large and constantly increasing marketing area of King County makes it a natural center of ceramic industry. Additional sources of ceramic raw materials within the county will depend upon further prospecting in the coal-mine areas for shales suitable for making expanded aggregates, and in the areas near the Blum, Kanaskat, Kangley, and Kummer deposits for high-alumina shales for refractory raw materials.

A recent development has been the importing of clay material from California to the Seattle area. Quantities of imports are not available, but it is estimated that the difference between 1964 production of about 107,000 tons and 1957 production of 181,000 tons is made up of imports. Based on this

assumption, imports to the Seattle area probably approximate 75,000 tons annually.

Many clay mines near Seattle have been subject to zoning restrictions and have been closed. A specific example is the Taylor clay mine and plant formerly operated by International Pipe & Ceramics Corporation. The mine and plant were purchased by the City of Seattle, and the plant was dismantled to protect the city watershed; operations ceased in 1950.

Clays suitable for manufacturing structural clay products are widespread in Pierce County. Currently, Builders Brick Company digs an altered white to light-gray andesitic rock from the Clay City pit. The material is made into structural clay products at a plant with capabilities of 50,000 equivalents per day. The only significant deposit of refractory-grade clay in the county is the LaGrande property in cuts and pits along the Chicago, Milwaukee, & St. Paul railroad half mile north of La Grande. The clay was mined and processed in past years by Denny-Renton Clay & Coal Company at a plant near La Grande.

Lowell Brick Company digs clay from a glacial deposit at Lowell in Snohomish County for manufacturing common brick. Reserves are extensive, but not much exploration has been done. The clay products are marketed in the Puget Sound Area and in central Washington.

The carbonaceous shale deposits near Sumas in Whatcom County constitute the only known deposit of clay better than structural grade in that area. The Sumas clay mine, operated in past years by International Pipe & Ceramics Corporation, yielded a carbonaceous shale with a p.c.e. (pyrometric cone equivalent) of 31. On an ignited basis, the Fe_2O_3 content was 2.45%; Al_2O_3, 47.33%; and SiO_2, 49.82%.

Lynden Clay Products, Inc., has in the past intermittently operated a structural clay plant near Everson.

Shales in the Waterman Peninsula area of Kitsap County exhibit good expansion properties. The location, on waterways to Seattle, Tacoma, Olympia, Bremerton, Everett, and Bellingham, makes this area an ideal location for an expanded aggregate plant. More extensive prospecting of these shales is needed. Presently, there are no clay industries operating in the county.

Clays are mined for manufacturing cement in King, Skagit, and Whatcom counties.

In general, specifications for clays depend upon end use and are based upon the method of preparation and physical and chemical tests of the products. Many producers and consumers rely on their own tests and specifications applicable to their specific needs; however, numerous specifications have been established by the American Society for Testing Materials; American Foundrymen's Association; American Oil Chemists Society; American Petroleum Institute; Technical Association of the Pulp and Paper Industry; and other organizations.

For ceramic purposes, there are no direct substitutes for clays, although there are alternate materials for almost all ceramic clay products. Wood, glass, concrete, plastics, various metals, and other materials may be used in place of ceramic clay products. There are alternate materials for most clays used for nonceramic purposes. In many nonceramic uses, clays are used because they are less expensive than other materials having equal or better qualifications.

Cinders, blast furnace slag, pumice, and perlite are substitutes for expanded shale and clay lightweight aggregate in some uses. Argillaceous limestone (cement rock), where available, reduces or eliminates the need for clay in manufacturing cement.

Fire clay and kaolin have a complex relationship with a wide variety of other refractory materials, including silica, dolomite, magnesite, chromite, graphite, bauxite, olivine, and rare-earth oxides.

Transportation is a relatively small factor in the clay-processing industries. Most of the miscellaneous-clay and fire-clay processing plants obtain their supply of raw material from deposits adjacent to the plants. An exception is the International Pipe & Ceramics Corporation clay processing complex near Renton. The company hauls clay by truck to the Renton plant from pits up to 27 miles distant. Since 1957 clay has been imported to this area from California. Tonnages imported probably approach 75,000 tons annually. Transportation is a major factor in marketing of brick, tile, lightweight aggregates, and other clay construction products. Only in special instances can the marketing radius exceed a few hundred miles.

Intense competition from other construction materials is threatening the structural clay products industry; in some cases, principal competing products, such as glass, metals, conventional and special concrete, are replacing clay brick and tile.

Fire-clay industries also are threatened by competition. In some local areas, the high-grade fire-clay deposits are becoming exhausted. Com-

petition from other refractories is increasing because of technological changes and because of higher maintenance and replacement costs involved with fire-clay products. Data are lacking on the quantities of clay and shale suitable for production of expanded lightweight aggregates and for other uses in the Puget Sound Area. Lack of adequate data on potential markets for lightweight clay and shale aggregate prevents the optimum growth of the lightweight aggregate industry.

Lime

Lime is regarded as a basic industrial chemical and the starting material for a wide variety of chemicals. In the Pacific Northwest, it is used in the construction industry for finishing lime, masons lime, and for soil stabilization. Also, lime has wide application in the metallurgical industries where it is used in ore concentration, smelting, and refining copper and aluminum, and as a flux in steel making. Other major industrial uses of lime in the Pacific Northwest include the pulp and paper and beet sugar industries. The neutralization properties of lime permit its use for sewage and water treatment of industrial, municipal, and agricultural water and wastes. Lime production in the Pacific Northwest in 1964 is shown in Table 11.

Lime production figures cannot be revealed for the State of Washington or for the Puget Sound Area, because it would reveal individual company data. Significant past production of lime in the Area for open-market sale has come from two operations. From 1925-56, Roche Harbor Lime & Cement Company produced lime from limestone mined near the plant at Roche Harbor, San Juan County. The plant was permanently closed on September 30, 1956, and subsequently dismantled. In 1963, Pacific Lime, Inc., began production from a 250-ton-per-day lime plant at Tacoma, Pierce County. Limestone for the operation comes from company quarries at Texada Island, British Columbia. The Tacoma operation currently is the only lime producer in the State manufacturing lime for open-market sale. Small amounts of lime have been produced in the past from intermittent operations in King, Snohomish, and Whatcom Counties. Captive-lime plants in the State, where lime is manufactured by a specific industry for its own use, include operations at sugar refineries in Grant and Yakima Counties. Re-use of lime is customary in the pulp and paper industry. Reclamation plants recarbonate the used lime sludge, dewater it, and recalcine. Regenerated lime from pulp and paper operations accounts for a large part of the total lime production in the Puget Sound Area.

TABLE 11.—Lime production in the Pacific Northwest, 1964[1]

	End use	Production (short tons)
Captive operations	Sugar refining	170,120
	Other[2]	110,207
Total lime used		280,327
Non-captive operations[3]	Metallurgical	14,004
	Pulp and paper	42,151
	Water treatment	1,910
	Other[4,5]	51,803
Total lime sold		109,868
Total lime production		390,195

[1]Excludes lime regenerated from calcium carbonate sludge at pulp mills.

[2]Includes lime produced at operations and used directly for metallurgical purposes, sewage treatment, and manufacturing calcium carbide. A distribution by specific use cannot be given because it is individual company confidential data.

[3]Includes production that was sold by Pacific Lime, Inc., Tacoma, Wash.; Elliston Lime Co., Elliston, Mont.; Chemical Lime Co., Baker, Oreg.; and Ash Grove Lime & Portland Cement Co., Portland, Oreg.

[4]Includes lime sold for sewage treatment, petroleum refining, manufacturing calcium carbide[5], and for tanning, construction, agricultural, and unspecified purposes. Part of this category was specified by producers regarding end use. A distribution by specific use cannot be given because it is individual company confidential data.

[5]The average annual quantity of lime sold for manufacturing calcium carbide from 1962-64 was 24,800 tons.

Apparent lime consumption in the State of Washington is shown in Table 12. Per capita consumption figures are compared for Washington and the United States. In 1964, Washington per capita consumption was about one-half of the United States figure, or about 50 pounds per person as compared with about 100 pounds per person consumed in the United States. It is estimated that about 350,000 tons of lime is regenerated annually at pulp and paper mills in the State, and a large share of this production is in the Puget Sound Area. Significant quantities are produced in captive operations for use in sugar refining. In the Puget Sound Area, an estimated 47,000 tons of lime is consumed annually exclusive

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of that recycled at pulp and paper mills. In addition to this, approximately 140,000 tons or 40% of the State total recycled lime is regenerated annually for use at pulp and paper mills. Recycled lime production at pulp mills in the Puget Sound Area comes from operations of Crown Zellerbach Corporation, Port Townsend, St. Regis Paper Company, Tacoma, and Weyerhaeuser Company, Everett.

Quotations in Engineering News-Record (8) for delivered hydrated finishing lime in December 1965 were $52.00 per ton in Seattle, which was the highest delivered price recorded in the United States. The average price reported for 20 major cities in the United States was $38.94 per ton. The delivered price for pulverized quicklime was $48.00 per ton in Seattle and averaged $38.15 per ton for 13 cities in the United States.

There are no alternate materials, within a comparable price range, to replace lime in its use as an alkaline reagent in manufacturing chemicals and in many industrial uses. Finely ground limestone has largely replaced lime in agricultural uses because it lasts longer in the soil and requires less frequent application.

In building construction, gypsum plaster and wallboard have largely replaced the lime-sand plastered walls because of lower costs of installation.

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TABLE 12.—Apparent primary open-market lime consumption in Washing

Year	Imports[1]	Shipments to Washington[2]	Total apparent consumption
1950	24,214	37,136	61,350
1951	22,031	48,577	70,608
1952	15,762	51,994	67,756
1953	18,496	52,997	71,493
1954	25,524	45,872	71,396
1955	28,676	49,212	77,888
1956	31,053	46,761	77,814
1957	37,440	32,783	70,223
1958	15,551	32,187	47,738
1959	15,488	33,435	48,923
1960	17,392	30,543	47,935
1961	18,862	[3]451,011	469,873
1962	19,009	[3]471,041	490,050
1963	2,588	68,781	71,369
1964	80	73,195	73,275

[1]Imports of lime through the Washington customs district.
[2]Shipments to Washington of primary open-market lime sold in the United States.
[3]Includes regenerated lime and lime at captive operations. Regnerated lime totale
1962. Data are not comparable with other years.

Washington. Olivine output, mined by open-pit methods, is crushed and ground to various size fractions and marketed principally for use as foundry sand, rather than as a source of magnesia, to consumers in Western and Midwestern States and Canada. In 1964, crude material was mined by Northwest Olivine Company, Pacific Olivine, and Scheel Stone Company, in Skagit County, and by Olivine Corporation, Whatcom County. Olivine was processed by crushing, grinding, and sizing at plants of Northwest Olivine Company, Hamilton; Northwest Talc & Magnesium Corporation, Clear Lake; and Olivine Corporation, Bellingham. The Olivine Corporation operations at Bellingham have been described. (27)

To avoid disclosing individual company data, output of olivine cannot be shown for many past years. According to the Northwest Olivine Company, 1961 general report to stockholders, the company shipped to consumers 3,200 tons of olivine in 1958; 4,591 tons in 1959; and 6,674 tons in 1960. The material was valued at about $28.50 per ton, f.o.b. plant. Output has increased sharply in recent years, and in 1964, processed olivine tonnages were 26% greater than in 1963.

Although output of olivine has been used for foundry sand rather than a source of magnesia, in 1965 a pilot plant was constructed and operated at Bremerton to determine the feasibility of processing olivine for its magnesium content. Feasibility results of the pilot-plant operation are not available; however, it is not unreasonable to expect that the vast resources of olivine of the Twin Sisters Range will be sources of magnesia in the future.

In the United States, magnesium and magnesium compounds are produced from sea water, dolomite, ores other than dolomite, and evaporate deposits and lake and well brines. In 1963, about 74% of the caustic calcined and refractory magnesia sold or used by producers in the United States came from well brines, bitterns, and sea water, using calcined dolomite or lime in the process. The remaining 26% was from magnesite. About 2 million tons of dead-burned dolomite used for refractories and flux was produced from dolomite.

The principal magnesium ores other than dolomite for recovering magnesium are magnesite, brucite, and olivine. Eleven percent of the estimated 65 million tons of magnesite resources in the United States is in Stevens County. (6) Northwest Magnesite Company furnishes refractory magnesia to the steel industry from operations in Stevens County. The quantity of material mined each year cannot be given, because it would reveal individual company data.

Depending upon requirements, many refractories made from materials such as bauxite, alumina, zirconia, mullite, silicon carbide, and boron carbide may be used in place of magnesia refractories.

Specifications regarding specific uses for olivine are scarce, although the Steel Founders' Society of America has issued raw materials specifications for olivine. The specifications are used by the steel-casting industry as a control for purchasing olivine aggregate. To insure quality material, specifications are needed from founders of other metals. According to papers given in 1964 at the Northwest Regional Conference, American Foundrymen's Society, olivine can be substituted for zircon in many foundry applications. (22) Also, olivine fills out complicated shell cores better than zircon and has reduced the necessary amount of sand additives, with consequent reduction in costs at operations of Pacific Southern Foundries, Inc., Bakersfield, California. (5) Experience with the use of olivine from the Twin Sisters Range as a molding, facing, coremaking, and refractory sand at a Pacific Northwest foundry has been described. (11)

Peat

For the purposes of collecting and compiling economic and statistical data on the peat industry, the Bureau of Mines has classified peat into three general types—moss peat, reed-sedge peat, and peat humus. Moss peat consists chiefly of the poorly or moderately decomposed stems and leaves of several species of sphagnum, hypnum, and other mosses. Reed-sedge peat consists chiefly of the poorly or moderately decomposed remains of reeds, canes, and reed-like grasses and sedges, such as wire grass, saw grass, rushes, and cattails. Peat humus is peat which is so decomposed that its biological identity has been lost.

The peat resources of the United States have been surveyed extensively, and known reserves are estimated at approximately 14 billion tons of air-dried peat. Peat is found in 35 states in the United States; however, the principal deposits, or 90% of the reserves, are found in Minnesota, Wisconsin, Florida, and Michigan. Less than 1% of the total United States reserve, or an estimated 73 million tons, is in the Pacific coast states of California, Oregon, and Washington. Peat reserves at active operations in

Washington were estimated at 2 million tons in 1964, or 2% of the total peat reserves at active operations in the United States.

Peat deposits are numerous in the Puget Sound Area, and the resources have been described. (29) Nine of 14 peat deposits in the State with areas of 600 acres or more and 19 of the 21 deposits in the State with maximum depth of 40 feet or more are in the Puget Sound Area.

Peat production in Washington from 1959-64 is shown in Table 13. Production by county was not available previous to 1957, but most, if not all, peat production came from the Puget Sound Area. Peat moss and reed-sedge peat are the common types produced in the Area, although some humus is removed. Washington ranked first in peat output for the United States during the period 1951-54. In 1964, the State ranked sixth in domestic production, accounting for 5% of the national total. Output was from 15 operations, and King County led in peat production, followed by Snohomish, Thurston, Kitsap, Pierce, and Skagit Counties. Humus, peat moss, and reed-sedge peat were produced, and most was sold in bulk.

Before 1955, most domestic peat was sold locally in bulk because low-cost packaging materials had not yet been developed. With the advent of synthetic films, inexpensive moisture-proof containers became available, and large quantities of domestically produced peat are now packaged and distributed to all parts of the United States. In the Puget Sound Area, bulk peat usually is sold locally directly to consumers by the producer.

TABLE 13.–Peat production in Washington, 1960-64.

Year	Short tons	Value
1950	--	--
1951	45,304	$98,955
1952	42,580	111,386
1953	32,107	104,274
1954	43,134	153,058
1955	37,640	113,254
1956	37,043	128,964
1957	39,364	153,274
1958	34,642	115,941
1959	32,884	123,586
1960	27,770	120,748
1961	55,543	359,099
1962	42,762	288,215
1963	38,648	187,549
1964	35,017	170,497

Prices of peat vary greatly, but in general, the sales value depends chiefly upon the kind of peat, the degree of processing, and whether the peat is sold in bulk or packaged. In most instances, the value of packaged peat is about double that of bulk peat, and in 1964, the average plant price of bulk peat in the United States was $7.04 per ton, while the price per ton of packaged peat was $12.05. Peat sold in bulk for use in mixed fertilizers had the lowest average unit value ($6.14 per ton); packaged peat sold for packing flowers ($17.70 per ton), and peat for potting soils had the highest price ($68.86 per ton).

The average unit value for peat sold in Washington was $4.79 per ton in 1964, the lowest for any state. The average price per ton for all domestic peat sold in 1964 was $9.67.

Virtually all the peat consumed in the Puget Sound Area is used for agricultural and horticultural purposes. The outlook for the domestic peat industry is expected to be one of continued growth. Since 1945, the number of producers in the United States has more than doubled, and domestic output has increased more than fivefold. Consumption in the Puget Sound Area should continue upward, because peat is in demand by homeowners, landscape gardeners, nurseries, and greenhouses in most parts of the Area, particularly in urban and suburban areas. Future output, expected to reach 50,000 tons by 1980, is estimated from past production trends.

A continuing problem of both producers and consumers is the lack of an adequate classification system for identifying the various types of peat. The present and most generally accepted system which groups peats according to botanical origin, is overlapping and does not recognize their different chemical and physical properties. The problem currently is being resolved by American Society for Testing and Materials Committee D-29, which was organized in 1963 to stimulate research and formulate definitions and specifications relating to peats, mosses, humus, and related products.

Sand and Gravel

The terms consumption and production are used interchangeably for sand and gravel as stocks are relatively small and constant. Sand and gravel are not major commodities in foreign trade.

Sand and gravel production is divisible into two main classes: commercial production which consists of a particular plant's output with at least part of the material sold on the open market, and Government-

and-contractor production, which is produced exclusively for use on Federal, State, county, or municipal projects. If part of the production from a particular plant is sold on the open market, the entire output is placed in the commercial category.

Sand and gravel production in the Puget Sound Area for the period 1950-64 is delimited by commercial and Government-and-contractor (noncommercial) operations in Table 14. Sand and gravel production in the Area has ranged from 34 to 62% of the State output in the past 15 years; in 1964, Area output was 39% of the State total. The largest amount of sand and gravel production in the Area is in the Central economic subarea, and for the period 1960-64, output in that subarea was over 80% of the Area total. Most of the production in the Central subarea is from commercial operations.

Combined output of sand and gravel from the Northern and Western economic subareas for the past five years has been less than 20% of the Area total. The material from this area has been largely from Government-and-contractor operations. Much of the Government-and-contractor production in the Area is bank-run material which is used for roads.

The number of commercial sand and gravel plants operating in the Puget Sound Area is given in Table 15. Data were compared with State figures and show a range of capacity for producing plants in the State and in the Area.

In the State of Washington in 1964, there were 167 commercial sand and gravel plants, of which 94 were stationary, and 73 were portable or semiportable operations. About one-half, or 79 of these plants, were in the Puget Sound Area where sand and gravel was produced at 20 stationary operations shown in Figure 5, and 59 portable and semiportable plants.

The largest plants in the State, or all operations producing over 500,000 tons annually, are in the Puget Sound Area. Most, or 82% of the sand and gravel production in the Area, came from stationary plants. The remaining 18% came from a number of portable and semiportable operations throughout the Area. There are no stationary plants in the Western Economic subarea, and there is only one operation of that type in the Northern economic subarea. Nineteen of the stationary operations were located in the Central economic subarea.

TABLE 14. Sand and gravel production in the Puget Sound Area, 1950-64 (thousand short tons)

	Central Economic Subarea			North & West Economic Subareas			Puget Sound Area			
Year	Commercial	Non-commercial	Total[1]	Commercial	Non-commercial	Total[1]	Commercial	Non-commercial	Total[1]	State Total
1950	NA	NA	3,193			980	NA	NA	4,173	10,606
1951	1,272	1,079	2,351	2,898	1,304	4,204	4,170	2,385	6,555	10,547
1952	796	1,030	1,826	3,027	676	3,703	3,823	1,706	5,529	13,322
1953	898	915	1,813	2,922	422	3,343	3,820	1,337	5,156	11,183
1954	3,939	917	4,856	567	732	1,298	4,506	1,649	6,154	16,045
1955	4,396	1,372	5,768	588	533	1,121	4,984	1,905	6,889	21,645
1956	4,592	1,313	5,905	471	1,163	1,634	5,063	2,476	7,539	16,842
1957	4,742	3,565	8,307	609	1,037	1,646	5,351	4,602	9,953	20,415
1958	5,447	2,565	8,012	1,201	1,007	2,207	6,648	3,572	10,219	24,389
1959	5,227	2,223	7,450	1,514	906	2,465	6,741	3,129	9,870	21,360
1960	6,058	999	7,057	752	863	1,615	6,810	1,862	8,672	25,594
1961	6,021	2,082	8,103	491	1,029	1,520	6,512	3,111	9,623	18,994
1962	7,809	2,605	10,414	202	1,539	1,740	8,011	4,144	12,154	19,580
1963	6,872	1,355	8,227	783	1,024	1,807	7,655	2,379	10,034	22,760
1964	8,654	1,494	10,148	1,209	1,000	2,209	9,863	2,494	12,357	31,920

NA Not available.

1 Owing to rounding, individual items may not add to totals shown.

TABLE 15.- Sand and gravel production from commercial plants in Washington and Puget Sound Area, 1964.

Annual production (short tons)	Washington		Puget Sound	
	Number of plants	Total production (thousand short tons)	Number of plants	Total production (thousand short tons)
Less than 25,000	76	840	31	310
25,000–100,000	56	2,926	28	1,429
100,000–200,000	17	2,438	7	1,048
200,000–500,000	14	4,301	9	2,944
Over 500,000	4	4,132	4	4,132
Total	167	14,637	79	9,863

Because of the relatively low-unit value of sand and gravel, deposits are seldom surveyed in depth to determine reserves. As a result, few definite measures have been taken toward conservation; the supply generally has been considered adequate except in deposits near large cities. Indirectly, a measure of conservation can be considered as a result of using portable plants that are able to mine small, scattered deposits near points of application. Little or no regard has been given to the various ideas advanced for multiple land use for sand and gravel deposits.

Sand and gravel occur in the same deposits, but the relative proportions of each vary over a wide range from cobbles to silt. Consequently, the problem of producing aggregate to rigid specifications is difficult and involves combinations of many types of equipment, such as crushers, screens, washers, classifiers, and grinding units. Many operators are unaware of methods by which much of this processing equipment may be used efficiently. In addition, the wide range of specifications for construction sand and gravel set by Federal, State, and other Government agencies multiplies the difficulties faced by operators who attempt to furnish aggregates of a specified size distribution.

Except for bank-run sand and gravel produced largely by Government-and-contractor operators for road fill, most construction sand and gravel is processed to meet exacting specifications. With increased demand for washed aggregate, the problem of securing adequate supplies of wash water has been intensified with the accompanying problems of waste-water disposal. (23) The problems of land-use planning to allow extraction of sand and gravel before such deposits are lost forever by covering them with buildings are receiving some consideration. (1)

Standards set for sand and gravel used in roadbuilding and concrete construction tend to become more specific and rigid as regards shape, physical properties, and screen size. Specifications for construction sand and gravel are numerous and are published in detail by the American Society for Testing Materials, Federal and State highways officials, industrial organizations, and contractors' associations.

Specifications require tests for soundness, freedom from deleterious particles, resistance to freezing and thawing, adhesion of bitumens, size gradation, and many others.

Major construction programs will continue to be dependent upon supplies of large amounts of low-priced raw materials such as sand and gravel. Continuation may be expected of the Federal highway program, originally scheduled to be completed in 1972, with expansion of programs for interstate and primary systems and modernization of existing road systems.

TABLE 16. Sand and gravel usage in the Puget Sound Area, 1964[1] (thousand short tons and thousand dollars)

Use	Economic Subarea: Central Quantity	Central Value	Northern Quantity	Northern Value	Western Quantity	Western Value	Puget Sound Total Quantity	Puget Sound Total Value	State Total Quantity	State Total Value	Percent of State Total
Building	3,426	$3,750	601	$ 556	28	$ 25	4,055	$ 4,331	5,616	$ 6,496	72
Road material	4,147	4,089	577	490	632	529	5,356	5,108	21,933	16,036	24
Fill	2,085	1,316	282	134	32	22	2,399	1,472	3,111	2,054	77
Railroad ballast	141	72	4	3	--	--	145	75	376	271	39
Other[2]	313	278	49	48	4	3	366	329	884	1,114	41
Total	10,112	9,505	1,513	1,231	696	579	12,321	11,315	31,920	25,971	39

[1] Excludes special industrial sands.

[2] Unspecified purposes.

TABLE 17. Stone production in the Puget Sound Area, 1937-64

Type of Stone	Short Tons (Thousands)	Value (Thousands)	Counties Produced In	Years of Recorded Production
Basalt (crushed)	28,867	$37,341	All counties except San Juan	1937-64
Granite (crushed)	2,037	3,713	All counties except Island and San Juan	1937-64
(dimension)	7	37	King, Kitsap, Snohomish, Whatcom	1946-48, 1950-52, 1955, 1958-61
Limestone (crushed)	9,450	20,964	King, Pierce, San Juan, Snohomish, Whatcom	1929, 1933, 1937-64
Marble (crushed)	1	13	King, Snohomish	1959-60
Miscellaneous (crushed)	5,452	4,857	All counties except San Juan	1938-63
(dimension)	1	14	Skagit, Whatcom	1942, 1961, 1963-64
Silica, industrial (crushed)[1] (includes sandstone, quartz, quartzite, and special sands)	492	2,864	King, Pierce, Skagit, Whatcom	1937-64
Sandstone (dimension)	93	4,994	Clallam, King, Pierce	1937-43, 1946-64
Total[1] (crushed)	45,807	66,888		
(dimension)	101	5,045		
Grand total[1,2]	45,909	71,935		

[1] Compilation for industrial silica were obtained from industrial sand and stone classifications, and amounts are not added to totals shown.

[2] Figures in columns may not add to totals shown because of rounding.

Increased production of aggregate will be required to supply this demand as well as for construction of new schools, industrial plants, sewage and water treatment plants, and homes. The unit price may continue to be low, and specifications probably will tend to become more stringent. Operations in many areas will be dependent upon seasonal activity of the construction industry and suburban growth, although supplying new marketing areas may also curtail some operations through restrictive zoning legislation.

Stone

The term "crushed and broken stone" is applied to irregular fragments of rock crushed or ground to smaller sizes after quarrying. Classification

terms, such as traprock, granite, and miscellaneous stone are used in the broadest sense in the crushed stone industry. Traprock refers to all dense, dark, and fine-grained igneous rocks, such as basalt, diabase, and gabbro. Granite includes the coarser grained igneous rocks. The term miscellaneous is applied to stone that is not readily classified by producers; in the Puget Sound Area, it comes largely from intermittent portable operations at numerous areas. Riprap, a term designating usage, consists of heavy irregular rock chunks used chiefly for river and harbor work, such as spillways at dams, shore protection, docks, and other similar construction that must resist the force of waves, tides, or strong currents. Also, it is used as fill in roadways and on embankments.

Historical data regarding types of stone production in the Puget Sound Area were compiled from available information and are shown in Table 17. Basalt is the common type of stone quarried in the Area, although large amounts of limestone have been quarried for manufacturing cement and lime.

Stone production, as with sand and gravel, is divisible into two main classes: commercial production, which consists of a particular plant's output with at least part of the material sold on the open market, and Government-and-contractor production, which is produced exclusively for use on Federal, State, county, or municipal projects. If part of the production from a particular plant is sold commercially, the entire output is placed in the commercial category. Basalt or traprock accounted for 75% of the stone produced in 1964, and 24% of the traprock was from Government-and-contractor operations, Table 18. The remaining 25% of the stone produced was largely limestone for manufacturing cement; some granite, marble, dimension sandstone, and miscellaneous stone were produced, largely for building purposes.

In 1964, crushed stone was processed at 32 commercial operations in theArea, Table 19. Eight of the plants were stationary operations, each producing over 100,000 tons annually. The eight plants accounted for 83% of the stone produced at commercial operations in the Area. The remaining stone from commercial operations, or 17% of the total, came from 20 portable operations, each producing less than 25,000 tons annually, and four semiportable operations producing between 25,000 and 100,000 tons each. Highly efficient portable plants, mounted on pneumatic-tired wheels, are becoming more widely used. Such plants are used in locations where freight rates on stone produced at permanent plants make their cost prohibitive. An advantage of the portable plants, in addition to saving transportation cost on stone, is that they can be moved from point to point on a deposit with the result that selective quarrying may be employed. Use of small crushers requires greater rock fragmentation, and this results in increased drilling and blasting costs.

TABLE 18. Stone production from the Puget Sound Area by type of stone, 1964

Type of Stone	Thousand Short Tons	Value (Thousands)	Unit Value (Per Ton)
Traprock:			
Commercial	1,779	$3,277	$1.84
Noncommercial	833	873	1.05
Limestone	780	1,458	1.87
Other[1]	92	328	3.56
Total Stone[2]	3,484	5,936	1.70

[1] Includes granite, marble, sandstone, and miscellaneous stone.

[2] Owing to rounding, individual items may not add to totals shown.

***TABLE 19. Crushed stone production from* commercial plants in the Puget Sound Area, 1964**

Annual Production	Puget Sound Area Number of Plants	Total Production[1] (Thousand Short Tons)
Less than 25,000	20	178
25,000–100,000	4	271
100,000–200,000	3	530
200,000–500,000	5	1,614
500,000 and over	0	0
Total	32	2,593

[1] 83% of commercial stone produced was from stationary operations; 17% of stone was from portable and semiportable operations.

Stone usage in 1964 in the Puget Sound Area is shown by economic subregions in Table 20. The Area accounted for 34% of the stone produced in the State during that year. Concrete aggregate and roadstone are the major uses for stone in the Puget Sound Area

consuming 62% of the total in 1964. Output of stone for this use was greatest in the Central economic subarea.

About 14% of the total stone produced in 1964 was consumed as riprap, and 24% was used in manufacturing cement and other special uses.

Imports of crushed stone are significant in the Puget Sound Area; they consist chiefly of limestone and siliceous materials from Canada. Quantities of siliceous materials shipped to the Area from foreign sources are not available. Imports of limestone from foreign sources (Canada) to harbors in the Puget Sound Area are shown in Table 21. Imports from Canada have increased fivefold in the past six years, or from 96,273 tons in 1959 to 549,803 tons in 1964. Limestone from foreign sources was used at pulp mills in the Area before 1961. However, during that year, a cement plant in the area began using high-calcium limestone from Texada Island, British Columbia, and in 1963, a lime plant at Tacoma began using limestone from the same source. Requirements for limestone from Texada Island will increase upon completion of the two proposed cement plants at Seattle.

Washing is becoming more generally practiced in the crushed stone industry. A common method of washing, if the stone is merely coated with dust, is to use water jets upon the stone during its passage over screens.

TABLE 20. ***Stone usage in the Puget Sound Area, 1964*** **(thousand short tons and thousand dollars)**

Use	Economic Subarea: Central Quantity	Central Value	Northern Quantity	Northern Value	Western Quantity	Western Value	Puget Sound Total Quantity	Puget Sound Total Value	State Total Quantity	State Total Value	Percent of State Total
Bldg. dimension	29	$ 257	*1	$ 1	--	--	29	$ 258	W	W	–
Concrete and roadstone	1,416	2,430	522	519	203	$304	2,141	3,253	7,709	$ 9,745	28
Riprap	289	489	68	73	126	215	483	777	1,080	1,365	45
Other	60	247	771	1,402			831	1,649	1,488	3,761	56
Total[2]	1,794	3,423	1,361	1,995	329	519	3,484	5,937	10,276	14,871	34

[1] Less than 500 tons.

[2] Owing to rounding, individual items may not add to totals shown.

TABLE 21. Foreign imports of limestone to harbors in the Puget Sound Area, 1959-1964

	1959	1960	1961	1962	1963	1964
Everett	23,423	22,943	23,482	21,895	21,868	27,893
Port Angeles	22,893	26,597	31,918	28,994	29,870	29,100
Seattle	35,980	39,572	182,461	224,553	222,046	359,020
Tacoma	1,865	7,258	5,358	18,449	107,839	114,173
Other Puget Sound Ports	12,112	16,020	16,482	19,098	16,306	19,617
Total	96,273	112,390	259,701	312,989	397,929	549,803

Source: Dept. of the Army Corps of Engineers. Waterborne Commerce of the United States. Part 4, Waterways and Harbors Pacific Coast, Alaska, and Hawaii, annual issues.

Increasingly rigid requirements resulting through evolution of technical design have produced many different specifications for crushed stone. Many volumes have been written on specifications, testing, and test methods by such organizations as the American Society for Testing Materials and American Association of State Highway Officials. Generally, construction requirements demand stone that is clean, strong, durable, sound, and dense, particularly when it is used as coarse aggregate. Most construction operators purchase their stone on specifications based on physical properties. Many of these specifications differ widely, particularly with respect to the exact application of the stone and to a lesser extent to the geographic location. As a result, many types of rock are unacceptable for one or more construction uses since they are unable to meet the requirements.

Reserve of stone are large, but stone deposits of the character or quality required to meet specifications for a particular use are limited in some areas. Crushed stone is a high-bulk, low-unit value commodity, and its economic utility is restricted by its ability to compete on a delivered price basis with alternate materials or sources. Availability and cost of transporation often determine whether a particular deposit is or is not a commercial reserve.

During the past 25 years, the value of stone produced in the Area, largely on a delivered price basis, has increased from $1.46 per ton during the period 1940-49 to $1.55 per ton for the period 1960-64. When comparing these figures, in terms of constant 1957-59 dollars, the value of stone in the Area has declined from $2.23 per ton to $1.53 per ton during the same 25-year period.

Local shortages exist in rapidly urbanizing areas owing to zoning restrictions imposed as built-up areas encroach upon existing quarries; sometimes, buildings occupy ground that otherwise might have been worked for stone in the future. Metallurgical- or chemical-grade stone is a special case with definitely restricted distribution of deposits. Discovery of new sources is becoming increasingly difficult and expensive.

Based upon anticipated or planned public and private construction and continuation of various highway building programs, the quantity of crushed stone produced annually may be expected to increase. Further expansion of the roadbuilding program appears imminent, which would produce an accompanying demand for more road aggregate. Changes in roadbuilding technology caused by heavier and faster traffic also will increase demand for roadstone; currently, more stone is used for wide and heavy shoulders than for the pavement itself.

Present trends in methods for producing crushed stone tend to increase efficiency and reduce costs; increased concern is shown by producers about methods for dust control, water pollution, and noise in quarry operations.

No new uses for crushed and broken stone are in prospect. New quarries to produce aggregate for local buildings are frequently opened and later abandoned as programs are completed. Larger, well-established quarries will expand and modernize equipment as demand increases. Shipping radii of quarries possibly will increase through use of innovations such as unit trains and articulated railroad cars.

There is need for simplification and standardization of specifications for crushed stone aggregate. No uniform method is in actual use by the various states for designating aggregate gradation sizes. Suppliers would find it simpler and less costly if specifications for Federal, State, county, and municipal purchases, at least in similar areas, used identical specifications for the same type of construction.

Sand and gravel is interchangeable with stone under many construction specifications, and competition is keen where these occur together; profits usually are held to narrow margins.

The crushed stone industry is becoming interested in diversification into concrete products, ready-mixed concrete, and asphalt plants in order to sell service and dispose of surpluses profitably.

Silica

It is estimated that current consumption of silica-bearing materials in the Puget Sound Area, exclusive of low-grade construction materials, approximates 225,000 tons annually. Roughly 85% of the material is obtained from outside the region. In the Area, silica is used as a fluxing agent, for manufacturing amber glass, as a filter medium, as an abrasive, and for other specialized purposes. Substitute materials, such as olivine and zircon, relatively abundant materials in the Northwest, have been used successfully as foundry molding sands and are competitive with silica sand in some areas, but their high-unit costs restrict their use.

The glass industry is one of the most important users of the higher priced industrial sands produced in the Puget Sound Area. Sands used for glassmaking must meet definite specifications for both grain size

and chemical composition. Large tonnages of industrial sands are used in iron and steel foundries to make molds for castings.

Sandstone, quartzite, and crushed quartz are used as a flux in the metallurgical industry, by the chemical industry, and for manufacturing cement.

Smith Brothers Silica Sand Company operates a 100-ton-per-day plant at Auburn, Washington, which utilizes scrubbers, classifiers, conditioners, and flotation circuits to produce sand suitable for use in manufacturing amber glass. Northwestern Glass Company, Seattle, purchases most of the sand firm's output, and to meet the stringent raw material requirements for making amber glass, the sand must be carefully sized through 20 on 100 mesh, the alumina content of the sand must be held to 4%, plus or minus 0.1%, and the iron content must not exceed 0.15%. Sand is hauled by truck to the plant from nearby deposits which are estimated to have reserves of 50-years' supply at current rates of production. (4)

Other special sands are produced by Cavanaugh Molding Sand Company at Renton, International Pipe & Ceramics Corporation from its Pit 55, Pacific Building Materials Company, and by Manufacturers Mineral Company, Seattle. Pacific Silica Company, with headquarters in Seattle, operates quarries at Denison, Washington; Basin, Montana; and Oliver, British Columbia, Canada.

There is no nationally recognized market price for silica because of the fluctuation in value, specifications, and marketing of the industrial mineral. Silica materials generally have a low value per ton, and for this reason, transportation is a major factor in marketing. Value of silica depends upon the availability of a suitable market and upon the economics of producing a specified product. Prices and minimum acceptable grades for silica vary widely; specifications usually depend upon the use for the material.

Sand from the St. Peter sandstone formation, Ottawa, Illinois, is the standard with which silica sands in the Pacific Northwest are compared. In spite of the high delivered cost of this sand, it generally is used where the highest quality of silica is needed. St. Peter sandstone formation sands from Midwestern sources are charged at $2.00 per ton, f.o.b. mine, Ottawa, Illinois; however, such sands delivered to Pacific Northwest consumers cost from $12 to $16 per ton. Silica sand from Ione, California, priced at $5.50 per ton, f.o.b. Ione, sold in 1964 at a delivered price of $14.16 per ton at Portland, Oregon, and $15.06 per ton at Seattle, Washington.

At comparable costs, quartz also is imported to the Area and other parts of the Pacific Northwest from Oliver, British Columbia, Canada.

The average value of industrial sands sold by producers in the Puget Sound Area from 1960-64 was $7.41 per ton, f.o.b. mines. In contrast, sand produced in the Area sold for an average value of $5.92 per ton, f.o.b. mines, during the period 1950-59.

Important developments in the Pacific Northwest industrial silica field have been the opening of the Lane Mountain silica deposit, Stevens County, and development of a Bovill, Idaho, operation as sources of silica in the early 1960's. Future possibilities do not preclude Washington as an important source of silica for the Pacific Northwest. Expansion will probably come from producers already established in the area and possibly from deposits located near water transportation. The Chelan County silica-sand deposit, near Wenatchee, is a specific example; however, detailed analysis of these sands is needed before the feasibility of making materials suitable for industrial use in the Pacific Northwest can be determined.

Talc (Soapstone)

Output of talc (soapstone) in the Puget Sound Area, the only area where talc has been produced in Washington, has been declining steadily, Table 22. Production from the Puget Sound Area was less than 1% (0.3%) of United States mine production of talc and soapstone in 1964.

There are at least 10 deposits of soapstone in Skagit County, the only source of talc in the Area, and many were mined in the past for use as furnace blocks in soda furnaces at kraft-pulp mills. Present production is used as a carrier for insecticides or as a paint filler. None is mined for ceramic purposes, and most of the soapstone mining is intermittent.

In 1964, soapstone was mined at deposits near Marblemount, Skagit County, by Herman Smith, Skagit Talc Products, and Scheel Stone Company. Two operators sold crude material for grinding at plants of Northwest Talc & Magnesium Company, Clear Lake, and Miller Products Company and Stauffer Chemical Company, both in Portland, Oregon. Ground material was used in insecticides and paint manufacture. Another producer sold soapstone for sculpturing purposes.

With the exception of small quantities sold for sculpturing purposes, talc and soapstone have no end use in the crude form and usually receive some

treatment before being sold. At Skagit County operations, talc is handpicked at the mines and shipped to grinding plants at Clear Lake and Portland, Oregon. Following crushing, roller mills, in closed circuit with air separators, are used for fine grinding the soapstone to sizes ranging from 100 to 325 mesh.

Although not used in Washington, fluid-energy grinding mills are used in other parts of the United States to make products of finer particle size than are attainable with standard mills. The product, popularly called micronized talc, sells for a premium price.

TABLE 22. Soapstone production in the Puget Sound Area, 1950-1964

Year	Short Tons	Value
1950	6,171	W
1951	6,300	W
1952	8,920	W
1953	5,351	$28,833
1954	3,493	W
1955	5,319	W
1956	4,627	W
1957	4,065	24,525
1958	4,000	20,680
1959	4,073	22,724
1960	2,406	12,233
1961	2,927	22,914
1962	2,835	11,070
1963	2,969	17,518
1964	2,680	18,372

W Withheld to avoid disclosing individual company data.

Prices for talc and soapstone are negotiated between buyers and sellers on the basis of a wide range of specifications. Grades and specifications for talc and soapstone usually are identified with the end use, such as filler, ceramic, steatite, cosmetic, and pharmaceutical grades. The unit value of soapstone from Skagit County operations in 1964 was $6.85 per ton, f.o.b. mine.

A great variety of grades of talc and soapstone are produced in California and the same general price range prevails for the materials from other producing areas. For comparison purposes, California talcs are valued in the range of $8 to $75 per ton, f.o.b. mines, and ground and bagged material is priced as follows: soapstone and grades of talc used mostly as fillers—$17 to $20 a ton; ceramic and paint talcs—$30 to $32; steatite-ground talc—$35 to $40; cosmetic and pharmaceutical talcs—$35 to $50; and micronized talcs—$50 to $100.

Talc and soapstone reserve data are lacking for the State of Washington. Quantitative data on domestic talc and soapstone resources are not complete, but about 90 million tons of reserves have been estimated on the basis of available information. (7) Additional deposits will probably be discovered in some of the major producing areas for which reserve data are lacking. The largest known ore bodies, containing over 50% of the known reserves, are in New York. Deposits in Vermont comprise 30% of the reserve, and the remaining 20% is distributed between California, Georgia, Montana, Nevada, North Carolina, and Texas.

Competition of talc and soapstone with other materials is determined partly by price and partly by performance. Kaolin, fullers earth, diatomite, limestone, and other nonmetallic fillers are common competitive materials. Many of the uses for talc and soapstone can be filled either by other natural materials, such as clays, diatomite, feldspar, and kyanite group minerals, or by manufactured or processed materials. Competition from these materials imposes limits beyond which it is difficult to develop new talc markets or even to maintain and expand those already existing. The development of standard specifications for talc and soapstone has been hindered by the diversity of physical and chemical properties of the materials from different parts of the country.

While large producers have developed improved processing methods and can turn out high-quality products with little variation from year to year, the small operators do not have the facilities or capital to achieve and maintain such quality and are, therefore, at a disadvantage in marketing their products. It is unlikely that the small talc and soapstone operators in Washington will follow United States consumption or mine production patterns and trends.

METALS

Copper

Average grade of copper ores produced in the United States has declined steadily from 3.3% in 1889 to 0.73% in 1964. Improved mining and processing techniques have made it possible for producers to mine low-grade ores previously thought to be uneconomical. For instance, Kennecott Copper Corporation reports in its 1964 report to shareholders that in 1915, average copper content of its Utah

copper mine ore was about 1.43%. In that year, 74,000 tons of copper was produced from the mine. In 1964, despite a strike and copper content of only 0.79%, 196,000 tons of copper was produced from the same mine. United States producers supplied 1,246,780 tons of copper from domestic holdings in 1964, or about 28% of world production of 5,420,000 tons.

Of 121,927 tons of copper produced in Washington from earliest records through 1964, 7,072 tons came from the Puget Sound Area. The largest production for any property in the Area was from the Sunset mine in Snohomish County in the 1920's. All copper production from the Area was less than 1% of domestic production in 1964.

The largest known copper reserves in Washington are in the Puget Sound Area at the Glacier Peak property in Snohomish County where resources are estimated at about 30 million tons of ore containing over 0.4% copper. Reserve estimates for the United States total about 32.5 million tons of copper contained in ore, or sufficiency for about 20 to 25 years' supply at current production rates, based on the assumption that the cost-price ratio will be such to permit mining ore having approximately the same grade as that now being produced.

The major portion of known copper ore reserves in the Pacific Northwest exist in the Butte, Montana, district. The Anaconda Company at Butte estimates the copper reserves of low-grade material amenable to open-pit mining methods are in excess of 300 million tons. The reserve estimate for the Puget Sound Area based on this estimate would be less than 10% of Pacific Northwest reserves.

Extensive drilling programs have been carried out in recent years at copper properties in King and Snohomish Counties. In 1961, Bear Creek Mining Company a subsidiary of Kennecott Copper Corporation, curtailed exploration in the Glacier Peak area because the U.S. Forest Service ruled that mining exploration could not be carried out by helicopter except on the few mining claims already established in the Glacier Peak Wilderness area. In 1962, Ridge Mining Corporation, another Kennecott subsidiary, assumed control of the Glacier Peak copper property from Bear Creek Mining Company. The Bear Creek firm had conducted extensive exploration on the property for several years.

In 1963, Bear Creek Mining Company optioned more than 50 mining claims from United Cascade Mining Company in King County. The prospect, located along the Middle Fork of the Snoqualmie River, was mapped, sampled, and diamond-drilled by a 15-man crew; however, the option was dropped in 1965.

Government restraints possibly will play a major role in developing the Glacier Peak property in the future; mineral development of the property could be deterred because of wilderness legislation.

Gold

Gold contributed the largest total value for metal production in the Puget Sound Basin, and output totaled 106,993 ounces valued at $2,688,884. Output has been from operations in Clallam, King, Pierce, Skagit, Snohomish, and Whatcom Counties (Table 23). Whatcom County mines have been the source of most gold produced in the Area, and about 85%, or over 90,000 ounces, came from this county. Important output from Whatcom County mines has been from the Boundary Red Mountain, Whistler, and Lone Jack mines in the Mt. Baker mining district, and from the Azurite, Mammoth, and new Light mines in the Slate Creek mining district. Both mining districts are in the North Cascades Primitive Area, which has been proposed for Wilderness Area legislation.

Much of the activity in gold mining occurred during the Great Depression years; in 1937, output from five lode mines in Whatcom County reached a record 13,197 ounces. In 1938, output from five lode and two placer mines in the county totaled 12,294 ounces. Output dropped to less than 500 ounces in 1940 and has never attained a peak of over 500 ounces annually since that time. Many gold-mining operations were curtailed as a result of War Production Board Order L-208, which removed labor and equipment priorities from gold-mining operations in 1942. The subsequent high cost of rehabilitation, plus a general increase in mining costs and a constant gold price, has prevented many mines from reopening.

TABLE 23. Gold production in the Puget Sound Area

County	Ounces	Value
Clallam, Pierce, Skagit	560	$ 14,036
King	7,127	157,647
Snohomish	9,107	205,980
Whatcom	90,199	2,311,221
Total	106,993	2,688,884

Manganese

Output of manganese from the Area approximates 52,000 tons of manganese ore containing 35% or more manganese, valued at $1.8 million.

The greatest amount of manganese was produced from operations at the Cresent mine in Clallam County. Output from the mine totaled 18,228 tons of ore containing 35% or more manganese for the period 1924-26. In 1942, record output of 10,660 tons was reported for the property, and during the period 1942-46, 32,008 tons was produced. Some manganese has been mined in Mason County.

Extensive tests and exploration work have been made on the manganese resources in Clallam, Jefferson, and Mason Counties. Two reports describing the manganese deposits also give a bibliography of investigations made concerning these resources. (12) (20) Sufficient exploration has not been performed to accurately estimate the potential tonnages of manganese available to the Puget Sound Area.

The United States has virtually no reserve of direct shipping manganese ore. Its reserves of ore from which a 35% or greater manganese concentrate can be produced by normal concentration methods are scattered and may approach 1 million tons, depending on premium prices.

The United States is one of the largest consumers of manganese ore in the world, using 2,241,756 short tons of ore containing 35% or more manganese in 1964. The large United States consumption, coupled with its small production of ore, 19,887 tons in 1964, makes this Nation the world's largest importer of manganese ore, and imports totaled 2,221,869 tons during that year.

The major categories of use for manganese and manganese ore in the United States are metallurgical, chiefly in the form of ferromanganese (94%); dry-cell battery manufacture (1%); and chemicals and miscellaneous (about 5%).

Other Metals

Small amounts of lead and zinc have been produced, largely as a byproduct at copper operations. Chromite has been mined in Skagit County, mercury in King County, and iron ore and molybdenum have been produced in Snohomish County. The total value of all these commodities was less than $100,000.

FUELS

Coal

Output of coal in Washington from five coal mines in three counties was 68,058 tons in 1964. King County led in coal production, followed by Thurston and Lewis Counties. Production of less than 1,000 tons, which is not compiled in annual Bureau of Mines tabulations for coal, was reported by producers in King and Pierce Counties.

In the Puget Sound Area in 1964, coal output was from underground mining operations in the Green River district in King County and the Wilkeson-Carbonado districts in Pierce County. In King County, Palmer Coking Coal Company, Inc., supplied coal from the Rodgers No. 2 and No. 3 mines near Ravensdale and the Franklin No. 10 and No. 12 mines near Black Diamond. Less than 1,000 tons was produced by Coal, Inc., from the Black Knight mine near Ravensdale. In Pierce County, less than 1,000 tons of coal was produced by Queen Coal Company at the Carbonado-Wingate mine near Carbonado.

Per capita consumption of coal in Washington in 1964 amounted to less than one-fourth (0.23) of a ton. This was considerably lower than the national average of 2.5 tons. Coal consumption in Washington totaled 715,000 tons in 1964, which was 78% below the total for 1944, Table 24. The decline is attributed to competitive fuels displacing coal in many sectors of the fuel economy. One of the important displacements has been the former lucrative coal market for railroad fuel, which presently is virtually nonexistent owing to the shift from coal to oil-burning equipment. Other inroads on coal markets have been made by other fuels competing for industrial and space-heating requirements where convenience of use is a major factor in consumption.

The coal consumed in Washington in 1964 was obtained chiefly from sources outside the State, principally Utah. Some was obtained from Wyoming, and Montana and Canada have been important sources.

Detailed data regarding specific consumer uses are incomplete, however, about 320,000 tons of coal was used at the Hanford Works at Richland, and approximately 100,000 tons was used at institutions and buildings owned or operated by agencies of the State of Washington. The remaining 295,000 tons was

used at Federal buildings, residential homes, commercial establishments, and at various industrial plants. Reliable consumption estimates cannot be given for the Puget Sound Area.

TABLE 24. Coal consumed in Washington. (thousand tons)

Origin of Coal	1944	1960	1964
Washington	1,511	222	68
Utah	769	607	600[1]
Wyoming	614	55	47[1]
Montana	394	--	--
Other	27	12	--
Total	3,315	896	715

[1] Estimated figures.

Source: U.S. Department of the Interior, Bureau of Mines, Division of Bituminous coal.

Adverse geological conditions, limited mechanization of mining operations, low productivity of workers, and extraneous matter that is mined with coal contribute to high costs of coal production in the Puget Sound Area. Factors which are directly related to the cost of coal production, such as productivity, amounts of extraneous matter, and types of mechanization are compared for Washington and surrounding States and the United States in 1964 in Table 25.

About 76 men were employed in coal mining in Washington in 1964. The average quantity of coal produced per man per day in Washington was 5.53 tons, the lowest productivity rate in the United States. The average productivity figure for underground mines in the United States was 13.74 tons per man per day.

Ninety-five percent of the coal produced in Washington in 1964 was washed and upgraded mechanically with jigs and concentrating tables. Of 98,663 tons of raw coal fed to cleaning equipment in 1964, clean coal totaled 64,905 tons, and 34% refuse. Percentage of refuse was higher than for surrounding states or for the United States average.

At Washington operations in 1964, there was a higher percentage of hand-loaded conveyor devices used than in comparable areas where loading and continuous mining machines were used more extensively.

From 1961-64, the average unit value of coal at the mine in the Puget Sound Area was $8.58 per ton. The unit value of coal mined in Washington in 1964 was $8.45 per ton. This was higher than for coal mined in 1964 in areas surrounding the Pacific Northwest and in the United States. For instance, the unit value of coal mined in Montana (bituminous) was $7.40 per ton, Utah coal was valued at $7.03 per ton, coal from Wyoming was valued at $3.15 per ton, and the average for the United States was $4.45 per ton.

Detailed analyses of coal have been published and are available for most of the fields in Washington. (2)(3)(26)(34) The coalfields in Washington are almost entirely in Eocene beds and are fossilized remains of the tropical coastal swamps of that time. The principal fields are subbituminous and bituminous coal and occur on the lower west slopes of the Cascades. Some fields of anthracite, northwest of

TABLE 25. Factors contributing to cost of coal production in 1964 for Washington and surrounding states

	Productivity	Extraneous matter		Mechanization			
				Type of underground loading devices used (percent)			
	(under ground mines) tons per man per day	Percentage of total production mech. cleaned	Percentage of refuse to raw coal	Loading machines	Continuous mining machines	Hand-loaded conveyors	Unit value of coal (dollars per ton)
Montana	6.09	W	W	96.2	---	3.8	$7.40
Utah	13.98	67.6	15.3	41.7	58.3	---	7.03
Washington	5.53	95.4	34.2	61.9	---	38.1	8.45
Wyoming	7.74	2.1	4.0	89.0	---	11.0	3.15
United States	13.74	63.7	20.1	54.3	44.4	1.3	4.45
Alberta	NA	NA	NA	NA	NA	NA	6.64
British Columbia	NA	NA	NA	NA	NA	NA	6.02

W Withheld to avoid disclosing individual company data.
NA Not available.

Mt. Baker and southeast of Mt. Rainier, are in places where the ordinary coal was so intensely deformed that most of the volatile components were driven off, leaving nearly pure carbon.

Coal reserves of the Puget Sound Area, Washington, and important surrounding States and territories are given in Table 26. Reserves of Washington, although large, are smaller in quantity than comparable resources in surrounding areas.

About 33% of the coal reserve estimate for the State is in the Puget Sound Area. Most of the bituminous coal reserves of the State, or about 1.6 billion tons, are within the Area situated in King (391 million tons), Pierce (362 million tons), Skagit (507 million tons), and Whatcom (320 million tons) Counties.

Subbituminous coal reserves of Washington, comprising 67% of the total coal reserve estimate, occur south of the Area boundary in Lewis and Thurston Counties.

In Washington, most of the coal reserve occurs in beds more than 42 inches in thickness and is interbedded with shale, sandstone, or other extraneous matter. Structural position of coalbeds plays an important part in the high cost of recovery.

Coalbeds in the Puget Sound Area are highly disturbed structurally. Seam dips of 50° or more are not uncommon, and numerous faults are present, particularly in the Green River district of King County and the Wilkeson-Carbonado and Fairfax areas of Pierce County. The coking coals of Pierce County warrant special attention because of their possible future use in metallurgical industries in the Pacific Northwest or their export to Japan. Coking coal has been produced in the past from the Wilkeson-Carbonado and Fairfax areas of Pierce County, and reserves are estimated at 242 million tons for these Pierce County fields. In both of the fields, the geologic structure is so complex that accurate estimates of minable reserves would necessitate detailed geologic mapping and exploration. Such exploration undoubtedly would increase the reserve estimate greatly.

The other important coal-bearing strata in Washington, in the Centralia-Chehalis district (largely subbituminous coal) of Lewis and Thurston Counties and the Roslyn coalfield in Kittitas County, are gently folded, and coalbeds generally dip less than 30°.

The dominant position of Utah coals in the Washington market is attributed to better quality as compared with Washington coals. Production costs from sources of coal surrounding the State are lower owing to favorable mining conditions conducive to mechanization of operations and a high rate of productivity.

Feasibility studies undertaken by private and public sources in the State of Washington indicate that coal can compete successfully with gas or oil and that reserves in the State are adequate to satisfy demand on a long-term basis. The Japanese steel industry has expressed an interest in the coking coals of Pierce County. Development of this market is a possibility if exploitation and preparation of the coal can be accomplished economically and a market outlet found for the middling coals that would have to be recovered from the high proportion of reject matter obtained in the preparation of coking coals of required specifications.

Petroleum and Natural Gas

No petroleum or natural gas has been produced in the Puget Sound Area. Records of the State Division of Mines and Geology show that from 1900

TABLE 26. Coal reserves of the Puget Sound Area and adjacent areas—(million tons)

	Publication date of estimate	Original estimate				Remaining reserves Jan. 1, 1960	50-percent recovery
		Bituminous	Sub-bituminous	Lignite	Total		
Montana	1949	2,363	132,151	87,533	222,047	221,705	110,853
Utah	1960	28,222	156	---	28,378	27,858	13,929
Washington	1960	1,908	4,155	116	6,185	6,185	3,093
Puget Sound	*1960*	1,580	441	---	2,021	2,021	1,010
Wyoming	1950	13,235	108,319	---	121,554	120,750	60,375
Alberta	1960	39,315	8,556	4	47,875	47,273	23,636
British Columbia	1960	17,832	---	998	18,830	18,546	9,273

Source: Bureau of Mines and (2).

to 1964, over 250 wells were drilled, and that over 400,000 feet of exploratory drilling has been done in the Area and immediate surrounding area in search of oil and gas. Most drilling has been in Whatcom County where 90 wells have been completed, and footage drilled totals 88,921 feet. Numerous shallow tests have been made in the county, and of the 88 wells completed, 53 wells were drilled to depths of less than 500 feet. King County ranks second with 59,995 feet of drilling at 22 dry holes. Snohomish County ranks third with 38,262 feet of test holes drilled. Pierce County has the record of deepest test, the Phillips Petroleum Company State No. 1, which was drilled in 1963 to a depth of 12,920 feet.

Results of oil and gas exploration in the Puget Sound Area have been described (10)(19).

INDUSTRIAL OPERATION REVIEWS

PRIMARY METALS

Aluminum

Olin Industries constructed the first aluminum plant in the Puget Sound Area at Tacoma during World War II. The plant, with primary aluminum reduction capacity of 21,000 tons annually, was taken over by Kaiser Aluminum & Chemical Corporation (formerly Permanente Metals) in 1947 and operated by that firm until 1958.

In 1964, because of a continuing increase in demand for aluminum, Kaiser Aluminum & Chemical Corporation partially reactivated its Tacoma plant, which has been shut down since 1958, and a new firm, Intalco Aluminum Corporation, announced plans to build a primary aluminum reduction plant near Bellingham. By year end, two-thirds of the Tacoma plant's 41,000-ton primary aluminum reduction capacity was in operation with the remainder to be activated in 1965. Intalco Aluminum Corporation, a joint venture of American Metal Climax (which owns 50%), Pechiney Compagnie of France (25%), and Howe Sound Aluminum (25%), planned to initiate production from a 76,000-ton-per-year capacity aluminum reduction potline by April 1966 at Bellingham. Two additional potlines of the same capacity, giving a total annual aluminum reduction capacity to the Bellingham plant of 228,000 tons, are to be on line in 1968, giving the Area a potential output capability of 269,000 tons of primary aluminum annually.

The major raw material for making aluminum is alumina, and about two pounds is required for each pound of primary aluminum produced. The new smelter at Bellingham is expected to be supplied with alumina from Australia, a distance of about 6,600 miles. American Metal Climax, a 50% owner of Intalco, signed an agreement with Western Aluminum, a subsidiary of Alcoa of Australia, Pty., Ltd., to supply some of the alumina requirements of the Bellingham plant. Both plants in the Area will be supplied with alumina by Queensland Alumina, Ltd., a consortium including Pechiney, Kaiser, Alcan, and Australian interests. The firm recently constructed an alumina plant with initial capacity of 600,000 metric tons near Gladstone in Queensland, Australia. Kaiser Aluminum & Chemical Corporation and the Port of Tacoma have announced plans to establish a facility for ship unloading and storage of alumina. Under the agreement, the Port of Tacoma will install by 1967 and operate the storage facilities for 40,000 tons of alumina which will be used at the company's Tacoma and Mead aluminum reduction plants.

Other raw materials required to produce a pound of aluminum include carbon anode electrodes (0.55 pound) and cathode carbon (0.02 pound) which are obtained largely from California suppliers of green petroleum coke. Also, small but important electrolyte materials, such as cryolite and aluminum fluoride (0.02 to 0.03 pounds each), are obtained from the southern States, and fluorspar (0.003 pound) comes from Montana.

The new smelter of Intalco at Bellingham probably will ship most of its ingot outside of the Western States to processing plants of its owners. Howe Sound, taking 25% of the output, has a rolling mill at Lancaster, Pennsylvania. The destination of the 25% share of Pechiney is not known, but may include the Howe Sound plant through Pechiney's interest in Howe Sound. The 50% share of American Metal Climax probably will go partly to the Hunter Engineering Division at Riverside, California, and partly to subsidiaries and affiliates in Southern and Northeastern states. Ingot from the Kaiser &

Chemical Corporation Tacoma plant goes to company rolling and extrusion mills at Trentwood, Washington.

Primary aluminum production for the Puget Sound Area has been projected to increase at an average annual rate of about 10%, or from 166,000 to 680,000 tons during the period 1965-80. (21) Employment for the same period was projected to grow at an average annual rate of 6%, or from 1,200 to 3,000 employees. In the study, it was expected that Pacific Northwest aluminum production growth would be comparable to that for the United States during the period 1975-85.

From 1985 to 2020, Pacific Northwest growth was estimated to be less than that nationwide; nuclear power, becoming less expensive by that time, will allow aluminum reduction plants to be located closer to the large aluminum markets. Aluminum output of the Puget Sound Area was estimated to reach 870,000 tons annually by 1985, and this figure was held constant to 2020 owing to lack of dependable information to the contrary. Aluminum production and raw material requirements by the industry in the Puget Sound Area are shown in Table 27.

TABLE 27. Aluminum production and raw material consumption in the Puget Sound Area

	1965	1980	2000	2020
Aluminum production (thousand tons)	[1]269	680	870	870
Raw materials:				
Alumina (thousand tons)	520	1,300	1,700	1,700
Carbon anode electrodes (thousand tons)	150	375	475	475
Cathode carbon (tons)	5,400	13,600	17,000	17,000
Cryolite (tons)	5,400	13,600	17,000	17,000
Aluminum fluoride (tons)	5,400	13,600	17,000	17,000
Fluorspar (tons)	800	2,000	2,600	2,600

[1] Estimated primary aluminum plant capacity planned by 1968.

Copper

American Smelting and Refining Company (Asarco) operates a copper smelter and refinery at Tacoma which is a custom operation capable of treating a charge of 600,000 tons of copper ores, concentrates, and fluxing materials annually. Refining capacity is 114,000 tons annually of refined copper. In addition, a 150-ton-per-day sulfuric acid facility utilizes sulfur-dioxide gas obtained from converters.

Refined copper is marketed mainly in Europe and the Far East; a small amount is shipped to domestic consumers. Sulfuric acid output, marketed by Stauffer Chemical Company, is used principally in fertilizer manufacture.

Smelting is carried out in two reverberatory furnaces and three converters; raw material shortages are common, and a large part of the time, only one reverberatory furnace is used.

The Asarco plant, with port facilities for loading and unloading ocean-going ships, receives a large part of its raw material from foreign sources such as the Philippine Republic, Canada, and South America.

In 1963, in an effort to insure future operations at the Tacoma copper smelter, which had been operating mostly on foreign ores, American Smelting and Refining Company agreed to assist in financing development of a copper property in northern British Columbia. The property, owned by Granduc Mines, Ltd., a subsidiary of Newmont Mining Company, was reported to have ore reserves of about 32.5 million tons averaging 1.93% copper. Under the agreement, American Smelting and Refining Company negotiated to process concentrates from the operation for 10 years and was to advance $10 million on the purchase of this material. Production, expected to begin early in 1968, is to be approximately 2.5 million tons of ore per year, from which concentrates containing an estimated 42,500 tons of copper was to be recovered.

Copper ores and concentrates used at the operation are the most significant raw material requirement and vary with the grade of ore processed, but average about 475,000 tons annually at full output. Other raw materials include about 90,000 tons of silica, obtained from a beach sand and gravel operation and from silica-bearing ores shipped to the plant, and 30,000 tons of limestone that comes from Texada Island, British Columbia. Employment at the Tacoma operation varies between 725 at full operation down to 525 employees when one furnace is in use.

Projections of copper output used in this study were developed as part of a study of the Pacific Northwest copper industry for the Bonneville Power Administration. (18) Estimated future copper production and associated raw material consumption are not expected to change significantly at the Tacoma

operation in the future. No additional expansion was predicted for the Tacoma smelter before 1980, and because output of copper metals is expected to increase only about 1% annually after 1985 in the Pacific Northwest, estimates are held constant to 2020.

In the study, the potential for discovering large copper deposits in the Pacific Northwest seemed best in western Washington.

Steel

There are three steel plants in the Puget Sound Area, all in Seattle, and annual electric-furnace steel-ingot capacity at the plants is about 400,000 tons, or 73% of the Pacific Northwest total. Two of the operations are steel rolling mills producing their own ingot, and one is an ingot-forging plant (also producing its own ingot).

Raw materials consumed in producing 1 ton of steel ingot include steel scrap (1.07 tons), coke (3.5 pounds), limestone (50 pounds), lime (20 pounds), dolomite (15 pounds), iron ore (12 pounds), carbon electrode (12 pounds), and fluorspar (1.2 pounds). Steel scrap is the most significant cost item, accounting for over 65% of the total estimated production cost for a ton of steel. Steel scrap is purchased from dealers in the Pacific Northwest; limestone and lime are obtained from western Washington operations; coke comes from petroleum coke producers in California; iron ore is shipped from Idaho and Nevada; and fluorspar is from near Darby, Montana.

Bethlehem Steel Company, Pacific Coast Division, operating the largest steel mill in the Pacific Northwest, revamped its plant at Seattle in 1958 which had been acquired by the company in 1930, but historically, the operation dates back to 1895. The change included two electric furnaces capable of yielding 420,000 ingot tons annually, but having an official annual capacity of 246,000 tons. Rolled products from this plant, made to standard steel specifications for hot-rolled, plain carbon, and low-alloy steels, are marketed in the Pacific Northwest and in part of Canada.

Isaacson Iron Works,[1] established in 1907 at Seattle, has equipment for providing 102,000 tons of steel ingot annually; also, this operation is capable of forging 60,000 tons and machining 30,000 tons of steel annually. Although forging capacity varies with the type of order, ship shafting maximum capacity is 60,000 tons per year, and the company has continued to make ship shafting since World War II. Occasionally, ingots are poured and forged to billets and in turn sold to steel mills for rolling. Forged products are sold nationally because there is little market for forging locally except for small shapes. Markets have been sought in foreign countries.

[1] Jorgensen Steel Company (1968).

Northwest Steel Rolling Mills, Inc., beginning operations in 1926 and currently operating two furnaces providing 53,000 tons of steel ingot annually, produces plain rounds, reinforcing bar, flat bar, and angles to supply markets in Portland, Spokane, Alaska, and Vancouver, British Columbia. About two-thirds of the output is reinforcing bar for concrete.

Projections of steel output used in this study were based on a study of the Pacific Northwest steel industry for the Bonneville Power Administration. (17)

Estimated steel production and associated raw material consumption are shown in Table 28 for 1964, 1980, 2000 and 2020. Steel production in the Area currently is entirely dependent on iron and steel scrap; there are no integrated iron ore reduction plants. In the future, it is possible that a prereduced iron ore pellet or sponge iron from a source outside the Area will be used to supplement the scrap charge. The projections of iron ore consumption were made using the present ratio of iron ore used per unit of steel produced. It is assumed that the present steel plant location at Seattle will exert influence upon the possible future smelting plant location, and that steel output will continue to be from the Seattle area.

TABLE 28. Projected steel production and raw material consumption in the Puget Sound Area—1965, 1980, 2000 and 2020

	1965	1980	2000	2020
Steel production (thousand tons)[1]	402	530	750	850
Raw materials:				
Steel scrap (thousand tons)	425	570	800	900
Coke breeze (tons)	700	900	1,300	1,500
Limestone (tons)	10,000	13,300	18,700	21,200
Lime (tons)	4,000	5,300	7,500	8,500
Dolomite (tons)	3,000	4,000	5,600	6,400
Iron ore (tons)	2,400	3,200	4,500	5,100
Fluorspar (tons)	240	318	450	510

[1] Kingston, Gary A. The Steel Industry of the Columbia Basin. A report for the Bonneville Power Administration, Portland, Oregon, 1962, 58 pp.

PULP AND PAPER

Pulp and paper industry requirements for mineral commodities are complex, and substitution of different raw materials shifts consumption trends sharply.

In general, calcium, sodium, and sulfur compounds are used by the paper industry in preparing cooking liquor at pulping operations. By digesting the wood with a cooking liquor, all the constituents of wood chips except cellulose, which is processed into various paper products, are dissolved and removed. At paper-making operations, chlorine which is made from salt (sodium chloride) is used for bleaching, and clays are used for coating and filler purposes.

Sulfate (Kraft) and sulfite-pulping operations and the chlorine-alkali industry are the important users of mineral raw materials for manufacturing pulp and paper in the Puget Sound Area. The groundwood-pulping process is a mechanical operation and does not use minerals.

No attempt is made to show the diverse chemicals produced by the complex chlorine-alkali industry other than to give the raw material (sodium chloride) consumption and source.

Sulfate-Pulping Process

The sulfate process of manufacturing pulp uses lime, chiefly for chemical recovery, and salt cake (sodium sulfate) in the system. An advantage of the sulfate process is that processing chemicals are recovered and returned to the system.

The largest application of lime in pulp manufacture is as a causticizing agent in sulfate plants where the waste sodium solution containing sulfate and carbonate ions is recovered and reacted with high-calcium lime to generate chemicals for reuse in the process. Either quicklime or hydrated lime can be used, but quicklime generally is preferred because the heat generated by its slaking hastens the chemical reactions.

The sulfate-pulping method would represent a significant market for soda ash except that large amounts of sodium hydroxide, a preferred substitute in the sulfate process, are produced by the chlorine-alkali industry in the Pacific Northwest.

The Kraft paper and paperboard industry requires an estimated 70%, or about 600,000 tons, of sodium sulfate output in the United States. Salt cake aids in digesting pulpwood by dissolving the lignin and releasing the cellulose fibers, which are processed into various paper products. In the cooking process, a portion of the sodium sulfate is reduced to sodium sulfide. Much of the salt cake is recovered and recycled, but in order to replenish losses, 100 to 200 pounds of the salt cake is required per ton of pulp, depending upon the type of wood being pulped and other factors.

Sulfite-Pulping Process

In the sulfite process of pulp manufacture, limestone is the source of calcium, and elemental sulfur is used to generate sulfur dioxide, which in turn is converted to sulfurous acid. Lime can be used in place of limestone; however, in the Pacific Northwest, limestone is used at most sulfite-pulping operations.

In the sulfite wood-pulping process, a sulfur dioxide compound is used to form water solubles of the nonfibrous constituents of the wood. Sulfurous acid alone can do this work; however, the industry uses a solution of a metallic bisulphite with a varying amount of sulfurous acid. Of the metallic bases, calcium and magnesium or a mixture of the two are the most commonly used, although sodium and ammonia also have been used in this process. The source of sulfur dioxide in manufacturing sulfurous acid at Pacific Northwest pulp mills is elemental sulfur. Pyrite can be burned to make sulfur dioxide for use in making sulfurous acid; however, no acid of this type is manufactured from pyrite in the area.

Substantial progress has been made in recent years in devising systems and installing facilities to recover process chemicals used in making sulfite pulp. The use of magnesium oxide, anhydrous ammonia, or sodium carbonate, rather than calcium carbonate which has been used largely in the past, allows recovery of chemicals to the processing system and thereby lowers the amount of wastes emitted from the plants.

Recovery of materials is not economically feasible when using the calcium carbonate process of manufacturing sulfite pulp.

The additions of new sulfite-production capacities in recent years have been considerably less than those of sulfate-pulp capacities, and this may be due in part to the fact that a recovery process for Kraft pulp spent liquors has been in use for many years.

The type of process and plant capacity, in tons per day, are shown in Table 29 for pulp and paper companies operating in the Puget Sound Area, that require significant quantities of mineral raw materials.

Operations in the Area account for 59% of the sulfite-pulp capacity and 37% of the sulfate-pulp production capacity in the State. The same operations comprise 48% of the sulfite and 20% of the sulfate-pulp plant capacity in the Pacific Northwest. About 30% of the total pulping operations in the Pacific Northwest is in the Puget Sound Area.

Capacity figures are difficult to evaluate as they depend on a number of assumptions which often are not stated. The considerable variance in capacity estimates among industry representatives suggests that the figures may be inflated; however, the figures are sufficient for compiling trends for mineral consumption. The estimated increase in future demand should absorb any existing unused capacity. At capacity operation about 575,000 tons of sulfate pulp and 775,000 tons of sulfite pulp would be processed annually in the Puget Sound Area.

Raw material requirements in 1964 for manufacturing pulp and paper in the Puget Sound Area are shown in Table 30.

TABLE 29. Pulp and paper companies of the Puget Sound Area, 1964

City	Firm	Pulp Process & Capacity (Tons Per Day) Sulfite	Sulfate	Total Sulfate-Sulfite Pulping Operations
Anacortes	Scott Paper Co.	120		
Bellingham	Georgia-Pacific Corp.	500		
Everett	Scott Paper Co.	775		
Everett	Simpson Lee Paper Co.		135	
Everett	Weyerhaeuser Co.	300	325	
Port Angeles	Crown Zellerbach Corp.	88		
Port Angeles	Fibreboard Paper Products Corp.	65		
Port Angeles	Rayonier, Inc.	375		
Port Townsend	Crown Zellerbach Corp.		400	
Tacoma	St. Regis Paper Co.		800	
Puget Sound Total		2,223	1,660	3,883
State Total		4,165	4,435	8,600
Puget Sound as percent of State Total		59	37	45
Washington-Oregon Total		4,635	6,635	11,270
Puget Sound as percent of Washington-Oregon Total		48	25	34
Pacific Northwest Total		4,635	8,185	12,820
Puget Sound as percent of Pacific Northwest Total		48	20	30

Sources: Post's Paper Mill Directory, L.D. Post, Inc., 1440 Broadway, New York, N.Y. 1964
Lockwood's Directory of the Paper & Allied Trades, Lockwood's Trade Journal, Inc., 1964

TABLE 30. Raw material requirements for manufacturing pulp and paper in the Puget Sound Area, 1964

Type of Operation	Mineral Raw Material Used	Estimated Unit Requirements (Pound Per Ton of Pulp Produced)	Short Tons
Sulfite-sulfate	Clay		25,000
Sulfate	Salt cake (sodium sulfate)	140	40,000
Sulfite	Sulfur	225	87,000
Chlorine-alkali	Salt	NA	370,000
Sulfate	Lime (makeup)	35	10,000
Sulfate	Lime (recycled)	NA	140,000
Sulfite	Limetstone	300	115,000
Sulfite	Magnesium oxide	120	0

NA Not applicable.

MINERAL REQUIREMENTS

Lime

An estimated 50,000 tons of primary lime is consumed annually at pulp and paper operations in the Pacific Northwest. The lime comes from operations of Chemical Lime Company, Baker, Oregon; Ash Grove Lime & Portland Cement Company, Portland, Oregon; Elliston Lime Company, Elliston, Montana; and Pacific Lime, Inc., Tacoma.

Limestone

About 115,000 tons of limestone is consumed annually at sulfite-pulping operations in the Puget Sound Area. Most of the limestone used at these operations in the Area is from Texada Island, British Columbia, Canada.

General requirements for limestone established by sulfite-pulp producers specify a minimum of 96% of calcium carbonate containing less than 0.7% iron and aluminum oxides, and less than 2% magnesium carbonate.

With recovery systems available, limestone consumption at sulfite plants in the Puget Sound Area can be reduced by substituting magnesium oxide, anhydrous ammonia, or sodium carbonate into the system.

Salt Cake (Sodium Sulfate)

Consumption of salt cake at sulfate-pulping operations in the Puget Sound Area approximates 40,000 tons annually. The present source of salt cake for Kraft pulp operations in Oregon and Washington, and some of that used in British Columbia, is from the Searles Lake operations in California of American Potash and Stauffer Chemical Co., West End Division. About one-half of the salt cake used in British Columbia Kraft-pulping operations and most of the material used in Idaho and Montana is supplied from the Saskatchewan producers of natural sodium sulfate. The product supplied by American Potash and Stauffer Chemical Co. has a minimum purity of 99% anhydrous sodium sulfate, while that supplied by the Canadian producers is slightly less pure, ranging from 97.5 to 98% minimum anhydrous sodium sulfate.

Most Kraft-pulping operators in the Pacific Northwest prefer the higher grade sodium sulfate from California, particularly those operations receiving salt-water borne logs. Sodium chloride impurities present in the natural sodium sulfate from Saskatchewan causes corrosion in liquor-burning furnaces and increased problems involved in liquor recovering operations. Study is needed to determine feasibility of leaching the salt-water-borne logs before utilizing the wood in pulp production in the Pacific Northwest.

The amount of salt cake required per ton of sulfate pulp produced has been decreasing. Efficiency has increased markedly in the utilization of this product by the sulfate-pulp producers. In 1949, over 200 lbs. of salt cake was required per ton of sulfate pulp produced; by 1954, the ratio had dropped to 174 lbs. of salt cake per ton of pulp; in 1962, it had dropped to 120 lbs. per ton with some mills using only 55 lbs. (24) (25)

Puget Sound Area pulp mill superintendents have indicated that an average of 140 lbs. of salt cake is required for each ton of sulfate pulp produced in the Pacific Northwest. (30)

Sulfur

Approximately 87,000 tons of elemental sulfur is consumed annually in manufacturing sulfite pulp in the Puget Sound Area.

The source of sulfur for sulfite-pulp operations in Oregon and Washington is largely from natural and refinery gases in western Canada. Some comes by boat from Frasch-process sulfur mines in Texas and Louisiana. The sulfur from Canada usually is in molten form, which reduces handling costs, fuel costs, corrosion of equipment, and product losses over that in bulk from the Gulf Coast States.

The delivered price of sulfur from Canadian sources ranges from \$26 to \$36.50 per long ton to Pacific Northwest consumers, whereas the delivered price of sulfur from the Gulf Coast ranges from \$37 to \$46 per long ton.

Sulfite-pulp producers require 99.5%-pure sulfur with a maximum of 0.3% insoluble carbon disulfide. With recovery systems available, sulfur consumption at sulfite plants can be reduced by as much as 65%. Consumption of sulfur at sulfite mills in Washington declined from 141,367 long tons in 1955 to 131,579 long tons in 1962. (14) The decline was due to installation of facilities to recover sulfur dioxide gas and other chemicals at one mill in the State and the closing of another mill with similar capacity that did not recover process chemicals.

Salt (Sodium Chloride)

The Pacific Northwest is an important salt-

consuming industrial area lacking in local salt-producing facilities.

Salt is reduced to chlorine, caustic soda, and numerous other chemicals by the *chlorine-alkali* industry in the Puget Sound Area. Caustic soda, sodium hydroxide (NaOH), commercially known as caustic alkali, lye or simply caustic, is recovered as a coproduct of chlorine from salt. Most of the chlorine and caustic soda production goes to the pulp and paper industry; some is marketed for use in petroleum refining, sewage treatment, food processing, agriculture, and for other industrial use.

The tonnages of salt shipped to Washington are shown in Table 31. Before 1960, most of the salt to the area came by rail from solar salt operations at Salt Lake City, Utah; since 1960, the greater part of the salt imported to the area has come by barge from Baja California, Mexico. In 1964, approximately 33% of the salt consumed by the chlorine-alkali industry in Washington was from domestic sources, largely from Solar Salt Company operations at Salt Lake City, Utah. The remaining 66% came from Baja California, Mexico. The delivered price of salt to Pacific Northwest consumers ranges from $7 to $12 per ton.

The chlorine plant capacity and estimated salt requirements of the chlorine-alkali industry in the Puget Sound Area are shown in Table 32. About 80% of the salt shipped to Washington, or an estimated 370,000 tons, is consumed annually in the Puget Sound Area.

The chlorine-alkali industry in the Area accounts for about 67% of the chlorine-caustic soda output in the Pacific Northwest. Chlorine-alkali operations in the Area include those of Georgia Pacific Corp., Bellingham, and Hooker Chemical Company and Pennsalt Chemicals Corp., both at Tacoma. Other chlorine operations in the Pacific Northwest include plants of Weyerhaeuser Corporation, Longview, Washington, and Pennsalt Chemicals Corporation, Portland, Oregon.

TABLE 31. Apparent consumption of salt in Washington, 1955-64

Year	Shipments to Washington[1]	Imports[2]	Apparent Consumption
1955	370	11	381
1956	408	1	408
1957	329	59	388
1958	291	45	336
1959	295	82	377
1960	129	249	378
1961	124	270	394
1962	175	290	465
1963	167	251	418
1964	159	324	483

1 Shipments to Washington of evaporated and rock salt produced in the United States.

2 Imports (largely from foreign sources) through the Washington Customs district for consumption of salt.

TABLE 32. Chlorine plant capacity in the Puget Sound Area

City	Firm	Chlorine Plant Capacity (Tons Per Day)	Estimated Salt Requirements (Short Tons Per Year)
Bellingham	Georgia Pacific Corp.	100	65,000
Tacoma	Hooker Chemical Co.	335	220,000
Tacoma	Pennsalt Chemicals Corp.	130	85,000
Puget Sound Total		565	370,000
State Total		710	460,000
Puget Sound as percent of State Total		80	

PROJECTIONS

The projections are made on the basis of least squares fits of both linear and logarithmic curves of data. Standard regression techniques are used, and two or more curves are fit to most data. The equations of the curves used are in the form $Y=a+b\,x$ and $\log Y=a+b\,x$. The correlation coefficients (r^2) of most fits were computed, and the best fitting curve selected. The accuracy of the projections varies greatly. The expected statistical error of regression techniques is not formally presented, but it is related

to the size of the correlation coefficient. The nearer the correlation coefficient approaches 1.00, the better confidence assumed in the projection.

Estimated mineral production in the area from 1980 to 2020, is shown in Table 33. Individual discussions are given for expected requirements of each commodity listed in the Table. A subregion analysis is given for common construction materials, such as cement, sand and gravel, and stone, since consumption of the materials is dependent to a great extent upon population growth.

TABLE 33. Estimated mineral production in Puget Sound Area, 1980-2020

	1964	1980	2000	2020
Cement (million barrels)	4.3	5.5	9.0	14.0
Clay (thousand tons)	107	125	150	175
Lime (thousand tons)	[1]47	70	100	175
Peat (thousand tons)	35	50	60	70
Sand and gravel (million tons)	12.4	15	25	35
Stone	3.5	5	8	10

[1] Estimated consumption.

CEMENT

Per capita consumption of cement in Washington, ranging from a low of 1.01 barrels in 1945 to a high of 2.36 barrels in 1958, has been higher than the United States average throughout the period 1940-60, Figure 3. In 1961, the State per capita usage (1.85 barrels) dropped below the United States average (1.92 barrels) and remained below it through 1964. The reason the State figures have been higher than the national average for many years has been due to large quantities of cement used at dam construction projects in Washington.

A correlation was prepared comparing Washington cement usage with that of the United States over the period 1950-64, but the test was not significant for prediction purposes. The derived trend line formula ($Y=2.42-0.27x$) over the period indicates a downward trend in per capita requirements for Washington compared to the United States total. It is not reasonable to expect the downward trend to continue, but Washington per capita requirements probably will remain below or equal to the United States figure.

The future estimates of cement production in the Puget Sound Area are based on an average annual increase of 2.5%, which is the figure derived for the commercial sand and gravel production trend in the Area appearing later in this report. The average annual production increase of 2.5% indicates per capita consumption requirements of about 2 barrels of cement in the Area throughout the period of this study, or per capita requirements of 1.96 barrels in 1980, 2.05 barrels in 2000, and 1.97 barrels by 2020.

The trend in the Puget Sound Area is toward reducing labor costs and cement prices by installing larger capacity plants and production machinery combined with centralized controls with electronic or automatic equipment. Firm commitments to install highly efficient cement-producing capacity of 8.5 million barrels annually have been made by companies operating in the Area. This proposed additional capacity will be sufficient to fulfill needs of the area until 2000 and possibly to 2020, if some existing plants in the Area remain in operation. However, as new capacity is completed, some older obsolescent high-cost production plants will be deactivated or revamped with automated equipment.

Estimated consumption of Portland cement by economic subarea in the Area from 1980 to 2020 is shown in Table 34.

TABLE 34. Estimated consumption of Portland cement by economic subarea, 1980-2020

Economic Subarea	1980	2000	2020
Central	4.8	7.9	12.4
Northern	0.4	0.6	0.9
Western	.3	.5	.7
Total Area	5.5	9.0	14.0

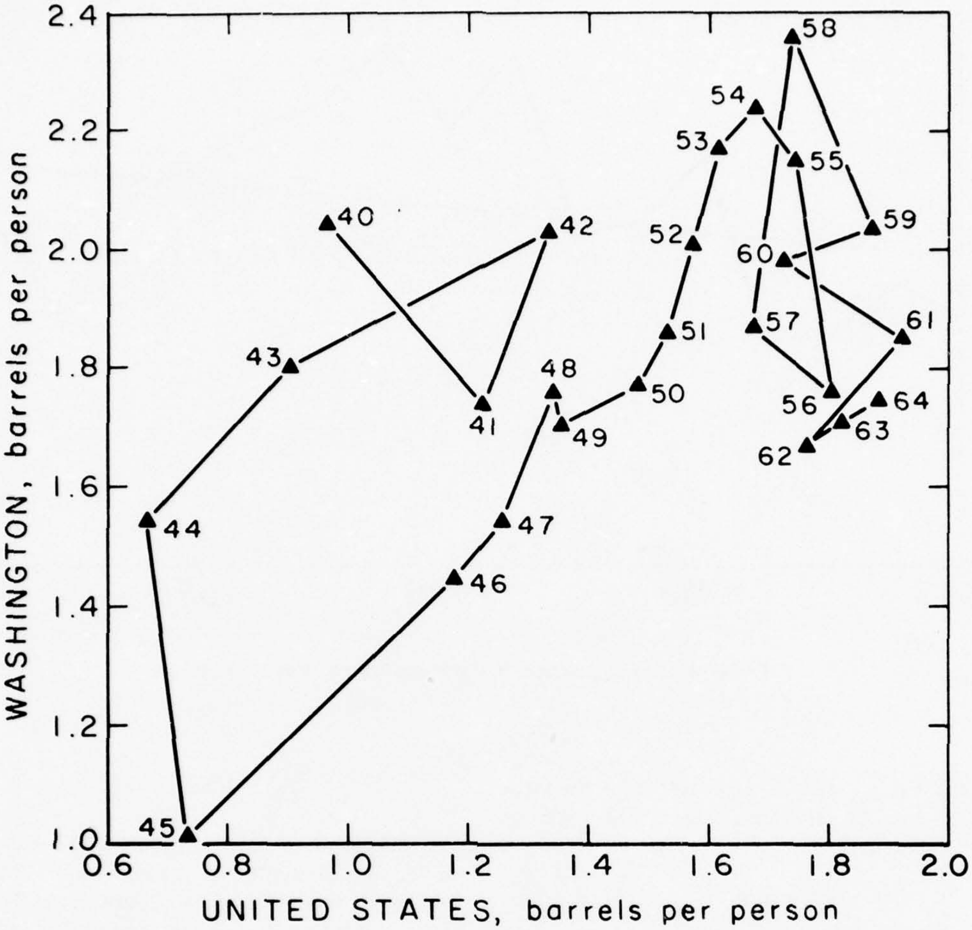

FIGURE 3. Washington versus United States per capita cement consumption, 1940-64.

CLAY

The trend of clay production in the Puget Sound Area for the period 1948-64 (Figure 4) is increasing at an average annual rate of 3%. However, since 1957, output in the Area has declined sharply because of clay imports from California. Growth estimates based on the regression trend line log Y=1.9896 + x (.0076) of clay production for the Puget Sound Area, therefore, are unrealistic. Future clay output in the Area is predicated upon anticipated brick consumption in the Pacific Northwest, increasing annually at a rate of 0.4% to 1985, (26) coupled with expected consumption of clay in manufacturing cement.

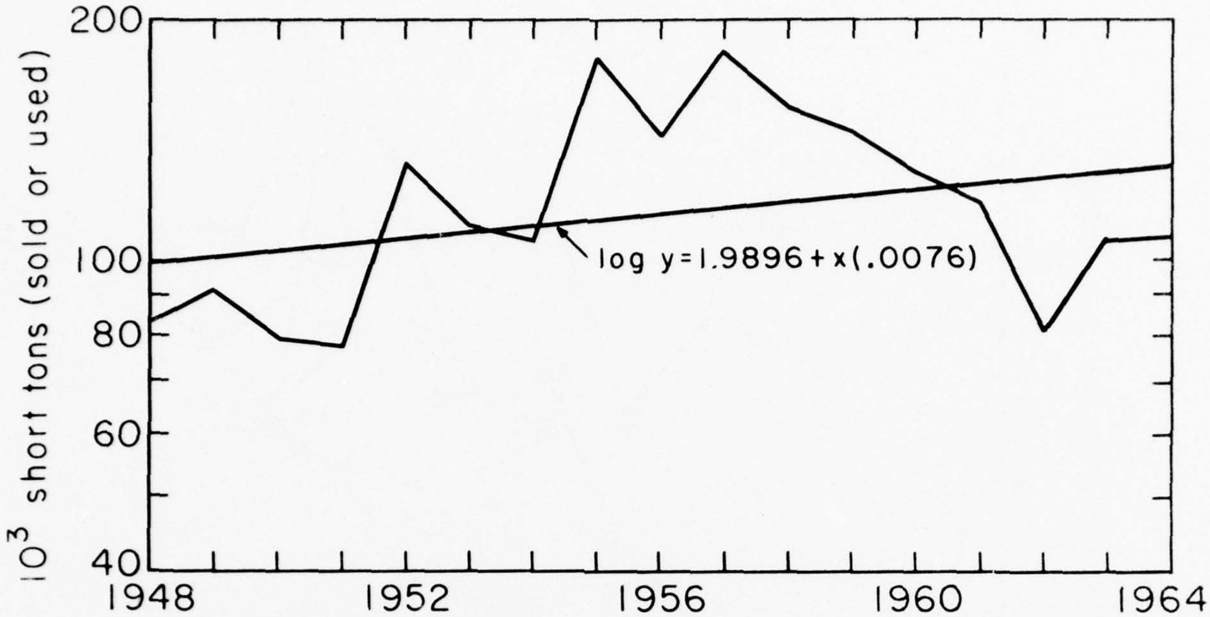

FIGURE 4. Clay production in the Puget Sound Area, 1948-64.

Predictions of total clay output in the Area imply an average annual increase of about 1%, or 175,000 tons, by 2020.

LIME

Based on per capita lime consumption figures for the State of Washington, consumption of primary open-market lime in the Puget Sound Area could more than double over present consumption, or reach 100,000 tons by 2000. Additional lime plant capacity possibly will be installed by that time to fulfill consumption trends. Advantages the Area holds for additional lime-producing facilities are nearness to high-calcium limestone deposits at Texada Island, British Columbia, nearness to major markets in the State, and tidewater location of transportation facilities. Estimates of primary open-market lime consumption in the Area to 2020 are based on per capita requirements of 0.025 ton.

PEAT

The outlook for the peat industry is expected to be one of continued growth. Since 1945, the number of producers in the United States has more than doubled, and domestic output has increased more than fivefold. Consumption in the Puget Sound Area should continue upward, because peat is in demand by homeowners, landscape gardeners, nurseries, and greenhouses in most parts of the Area, particularly in urban and suburban areas. Future output, expected to reach 50,000 tons by 1980, is projected from past production trends and implies reserve requirements of the magnitude of about 3.5 million tons by 2020.

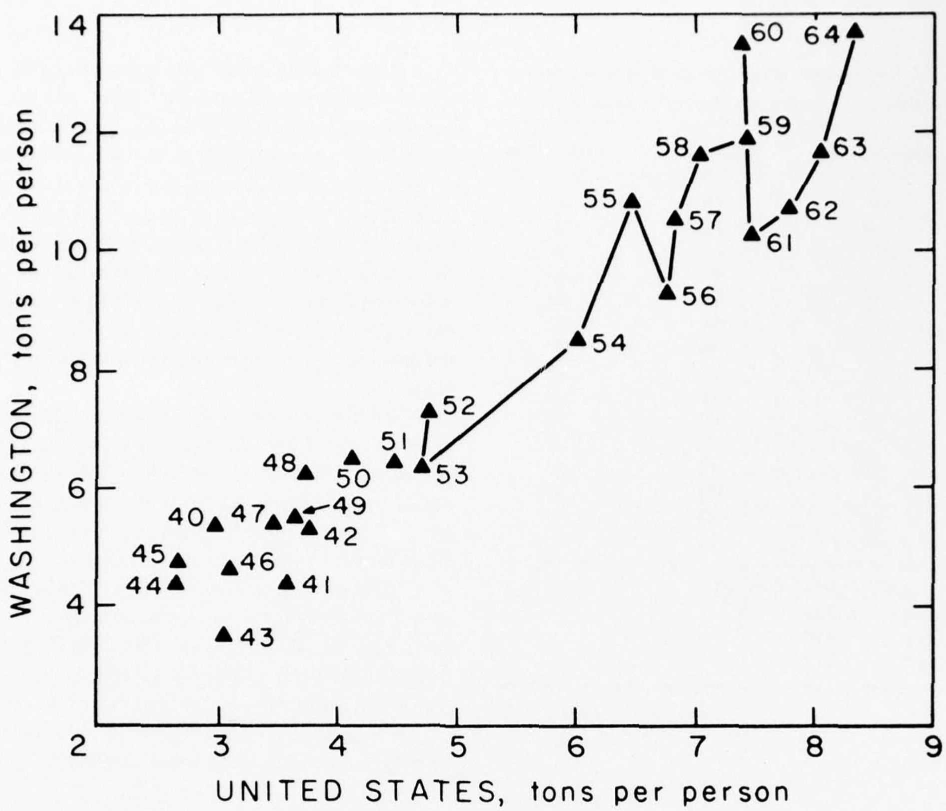

FIGURE 5. Washington versus United States per capita sand and gravel and stone production, 1940-64.

SAND AND GRAVEL AND STONE

Per capita consumption of aggregates in Washington, ranging from a low of 3.5 tons in 1943 to a high of 13.7 tons in 1964, is compared from 1940 to 1964 with United States figures, which have ranged from a low of 2.6 tons in 1944 to a high of 8.3 tons in 1964 (Figure 5). The reason that Washington per capita figures are higher than the national average is that the ratio of sand and gravel from Government-and-contractor operations in Washington is greater than the national figure. The ratio of sand and gravel going into road construction and at dam building projects is greater for Washington than the national average.

For the State, the percentage of sand and gravel from Government-and-contractor operations, ranging from 31 to 54% of total output during the period 1950-64, has been much higher than the United States average, Table 35. In Washington, the average annual sand and gravel output from Government-and-contractor operations over the 14-year-period was 50% of total output. The percentage of sand and gravel produced by Government-and-contractor operations in the Puget Sound Area has ranged from 20 to 46% of total output, and the 13-year average from 1951-64 is 30% of the total. It is expected that this trend will continue in future years, and output by Government-and-contractor operations is estimated to be 30% of total output in predicted estimates. The ratio follows the United States trend as the average annual output from 1950-64 from national Government-and-contractor sand and gravel operations, ranging from 26 to 31%, was 30% of total domestic production. Data are not available for the period 1950-63 at stone operations in the Area, but in 1964, Government-and-contractor operations accounted for 24% of total stone output. It is assumed that future production of stone will follow the trend of 30% from Government-and-contractor operations.

TABLE 35. Percent of total sand and gravel production from Government-and-contractor operations.

Year	Puget Sound	Washington	United States
1950	NA	50	30
1951	36	38	29
1952	31	48	31
1953	26	47	30
1954	27	31	29
1955	28	54	29
1956	33	48	25
1957	46	51	26
1958	35	52	29
1959	32	47	27
1960	22	57	26
1961	32	40	28
1962	34	35	27
1963	24	46	28
1964	20	54	28

Average annual percentage 1950-64:

Puget Sound	30%
Washington	50%
United States	30%

The projections for aggregates are based on the trend of commercial sand and gravel output in the Area over the period 1951-64 (Fig. 6). The time series correlation was significant at the 5% level of statistical inference, and the trend line Y=3 + 0.4x implies a 2.5% average annual rate of growth for the period of study, or until 2020. Projections for aggregates are made by assuming that this trend accounts for 70% of total production or the output from commercial firms. An additional adjustment of 30% compensates for production at Government-and-contractor operations.

Estimated per capita requirements for aggregates in the Puget Sound Area for the projected period of this study are shown in Table 36. The per capita requirements for sand and gravel range from about 5 to 5.75 tons, and per capita consumption of stone ranges from about 1.5 to 1.75 tons.

The predictions from 1980 to 2020 of sand and gravel production by economic subregion are shown in Table 37. Estimates of stone production from 1980 to 2020 by economic subregion are shown in Table 38. Stone requirements are adjusted upward by 1 million tons in subregion II to account for anticipated cement plant requirements for limestone.

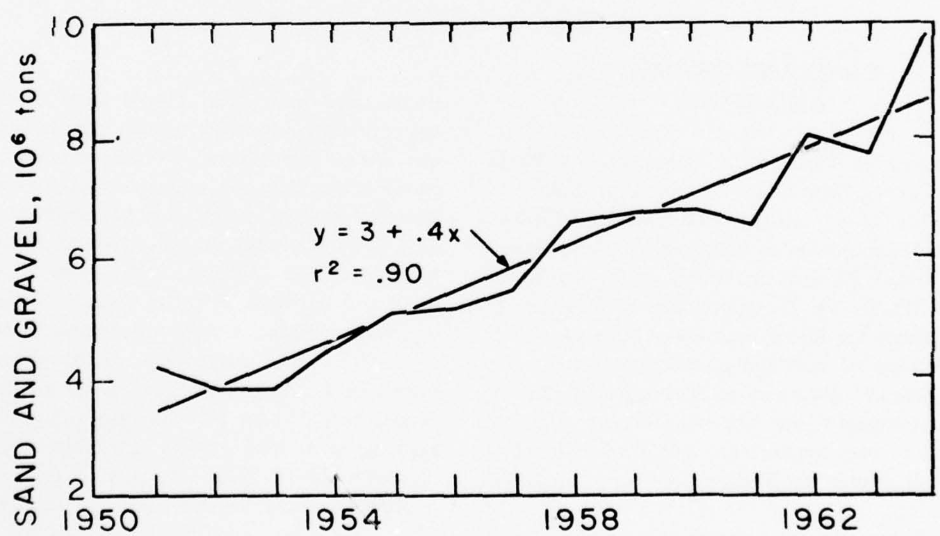

FIGURE 6. Sand and gravel produced by commercial firms in the Puget Sound Area, 1951-64.

TABLE 36. Estimated per capita requirements for aggregates in the Puget Sound Area, 1980-2020 (tons)

Year	Sand and Gravel	Stone
1980	5.85	1.79
2000	5.69	1.82
2020	4.93	1.41

TABLE 37. Estimated production (consumption) of sand and gravel by economic subarea, 1980-2020 (million tons)

Economic Subarea	1980	2000	2020
Central	13.0	21.9	30.9
Northern	1.1	1.8	2.4
Western	0.9	1.3	1.7
Total Basin	15.0	25.0	35.0

TABLE 38. Estimated production (consumption) of stone by economic subarea, 1980-2020 (million tons)

Economic Subarea	1980	2000	2020
Central	3.3	6.0	7.8
Northern	1.4	1.6	1.7
Western	0.3	0.4	0.5
Total Basin	5.0	8.0	10.0

MISCELLANEOUS MINERALS

Impressive quantities of coal have been produced in the Area in the past, but the high cost of coal production in the area, coupled with competitive coal sources surrounding the Area and the State, have led to sharp declines in output in recent years. Employment at coal operations in the Area in 1964 was less than 50 men.

Projections have been made for expected future production of coal and employment by the industry in the Pacific Northwest. (26)

The maximum range of the projections is based on a high level of productivity that possibly could not be attained in the steeply pitching coalbeds of the Puget Sound Area. Whereas in 1964, coal output in the Area was about 5.5 tons per employee, the projections imply output of about 30 tons per man by 1985. Minimum growth predicted in the study assumes productivity of about 7 tons per man for all future years; therefore, the minimum predictions for coal output are near current production in the Pacific Northwest. In the absence of dependable information to the contrary, it is assumed that demand for coal and coal output in the Area will remain constant to the year 2020.

Important, but small quantities of olivine, siliceous materials, strontium, and talc are produced annually in the Area. Employment at all mines and plants producing the materials is less than 100 men. Competition makes the future mine production of the materials uncertain.

In the case of olivine, the resource has not been developed to its maximum potential. Many foundry applications for olivine remain to be discovered, and the refractory potential of olivine deserve much more research and development than has been carried out. Olivine from the Twin Sisters area will maintain increased rates of production as the many potential requirements for the mineral are expanded in the future.

One of the few commercial strontium deposits in the United States, and the only one in the Northwest, is on Fidalgo Island, Skagit County, near LaConner. The deposit contains the two strontium minerals, celestite and strontianite, in approximately equal amounts. In past years, ore was mined intermittently by both underground and open-pit methods, and was processed by the operating company, Manufacturers Mineral Company. The crude material was ground to consumer specifications at the company plant in Seattle and marketed locally as a chemical material.

Copper, lead, zinc, gold, silver, chromite, iron ore, manganese, mercury, and molybdenum have been produced intermittently in small quantities. In 1964, only a small quantity of gold was produced, and employment at all metallic mining operations in the Area during the year was less than 50 men. Curtailment of gold-mining operations during World War II owing to manpower shortages and the war effort has hampered development of gold resources. Although the high cost of rehabilitation has prevented many mines from reopening after World War II, a gold subsidy program could possibly result in some mines in the Area reopening for further development.

Government restraint, such as wilderness legislation, could prevent development of these mineral resources in the Area, as the metallic mineral resources have not been delimited sufficiently to ascertain maximum or potential growth.

EMPLOYMENT

Employment trends in the mining and manufacturing industries in Washington, requiring significant quantities of mineral raw materials, are shown in Figure 7.

PRIMARY METALS

Employment is largest in the primary metals industry which is dependent upon local as well as national fluctuations of supply and demand. Employment in the industry reached a peak of 15,000 men in 1956. Lessened building construction, lowered demand for nonferrous metals, and particularly a cutback of defense procurement that affect the State aircraft industry, led to a lowered rate of expansion in the State in 1957 and 1958. National conditions influencing mineral markets were mostly unfavorable during the two years, particularly those demand factors relating to lead-zinc and copper mining, as well as aluminum and copper smelting and refining. For example, during 1957, the number of workers in the aluminum industry declined from a January total

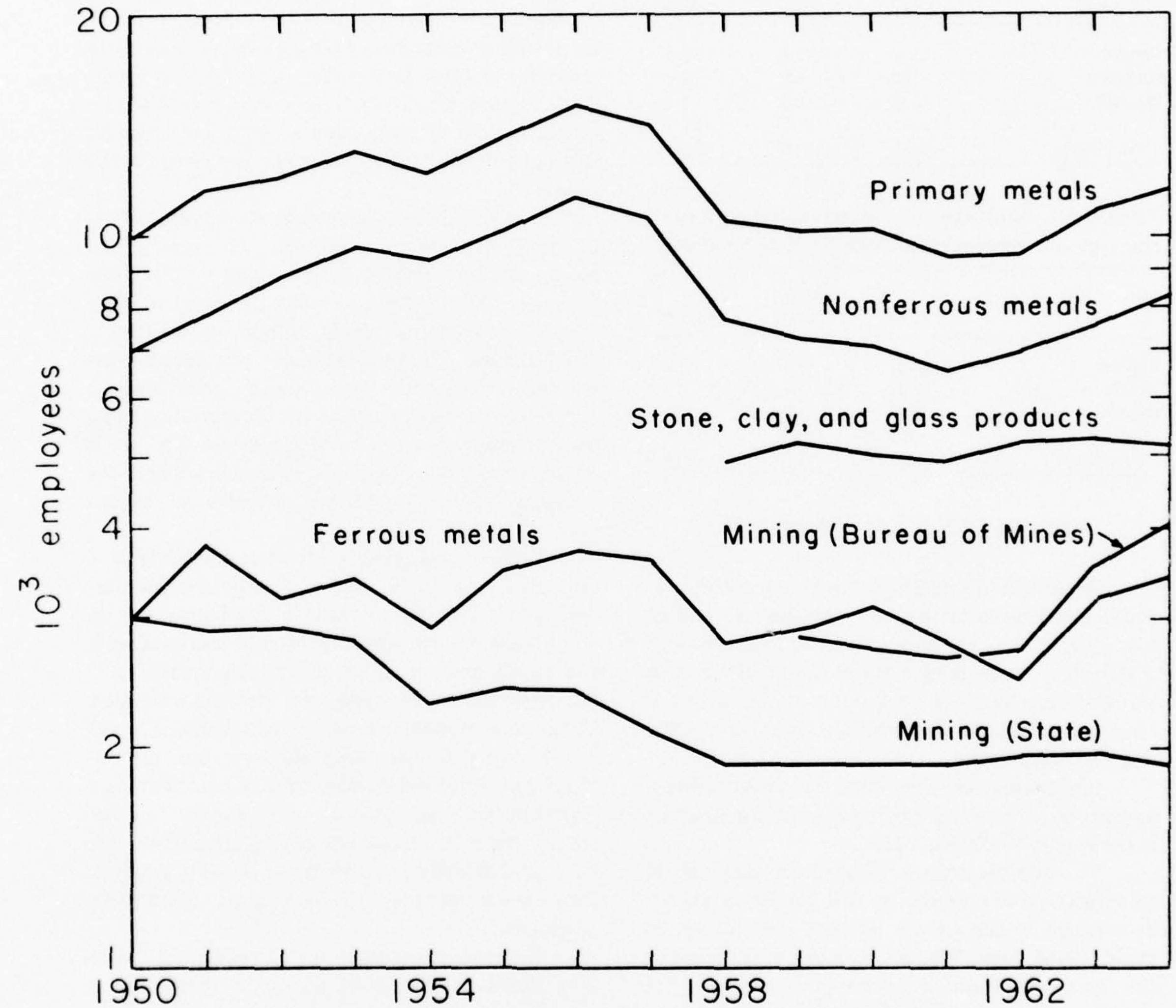

FIGURE 7. Employment trends in Washington for selected industries, 1950-64.

of 10,000 to 7,900 in December. Lower employment also occurred in smelting and refining other nonferrous metals, and layoffs were recorded for the steel industry late in the year. Employment in the primary metals industry has not reached the 1956 peak, and in 1964, total employment in the industry was about 11,600 men.

MINING

Figures published by the Washington Employment Security Department show that employment in mining has declined from 3,000 men in 1950 to 1,900 men in 1964. The decline possibly is due largely to classification methods; in 1958, the department compiled data for stone, clay and glass products which had been presented differently before that time, and some of the employment in mining possibly was included in that classification. Some mining employment by that department also is included in a classification for construction workers. Bureau of Mines records show that employment in mining has increased from 2,900 men in 1959, the first year of available information, to over 4,000 men in 1964.

Estimates of employment in 1964, prepared from information published by the Washington Employment Security Department and from Bureau of Mines records, are shown for mining and related manufacturing industries requiring significant quantities of mineral raw materials in the Puget Sound Area, Table 39. Employment is largest in the primary metals industry; about 3,800 men are employed at aluminum, copper, and steel reduction works in the Area. An estimated 3,650 men are employed by manufacturers included in the stone, clay, and glass products industrial classification. Employment is large in the concrete products sector of the stone, clay, and glass industry classification. There are about 25 concrete product plants in the Puget Sound Area with over 20 employees each, and total employment in manufacturing concrete products is about 3,000. Concrete products, such as ready-mixed concrete, concrete pipe, concrete block and brick, and precast concrete, are oriented toward local markets. Manufacturers of concrete products attempt to locate near primary raw material sources such as sand and gravel deposits or in proximity to cement plants or cement distribution terminals. About 75%, or an estimated 2,500 barrels of cement consumed in the Area in 1964, was used in manufacturing concrete products.

TABLE 39. Estimated employment in mining and related manufacturing industries requiring significant quantities of mineral raw materials in the Puget Sound Area, 1964

	1964	1980	2000	2020
Mining:				
Nonmetals:				
Cement-lime	425	400	400	500
Sand and gravel	825	900	1,150	1,300
Stone	450	550	700	800
Miscellaneous	75	100	100	100
Total nonmetals	1,775	1,950	2,350	2,700
Fuels:				
Coal	50			
Peat	45			
Petroleum (exploration)	55			
Total fuels	150	150	150	150
Metals	35	50	50	50
Total mining	1,960	2,150	2,550	2,900
Primary metals (smelting, refining, casting):				
Aluminum	1,200	3,000	3,700	3,700
Copper	600	700	700	700
Steel[1]	2,000	1,700	1,600	1,400
Total primary metals	3,800	5,400	6,000	5,800

[1] Steel employment projections are based on a 3.2% average increase in productivity for manufacturing steel ingot and an assumed constant figure for iron and steel foundry employment (650 employees).

An estimated 92% of the employment in mining in the Area is at nonmetal operations, particularly sand and gravel and stone operations, which accounted for about 70% of the total employment in mining in 1964. Coal and peat operations and petroleum exploration accounted for about 7% of the total employment in mining. Less than 2% of the total mining employment was from metal mining operations. About 70% of the total mining employment is in the Central subarea, 25% in the Northern subarea, and 5% in the Western subarea.

Projections for mining employment in the Puget Sound Area are dependent largely upon the outlook for sand and gravel and stone. Productivity is

an important factor in estimating employment trends for these commodities.

Relationships regarding productivity were compared for the sand and gravel industry in Washington, the United States, and California, the state with greatest production of sand and gravel in the United States. Average employee output per hour from commercial sand and gravel operations is shown for Washington, California, and the United States for the period 1958-63 in Table 40. Information for 1964 is not available, but in 1963, output per employee averaged 21,400 tons annually, or 11.5 tons per hour, from California commercial sand and gravel operations where 93.8 million tons was produced, which was more than double the amount of sand and gravel produced at commercial operations for any other state in the United States. Average output per man was over 8.0 tons per hour and ranged from 14,000 to 15,400 tons annually in three states (Illinois, Michigan, Ohio) where in excess of 30 million tons of sand and gravel was produced from commercial operations in 1963. The average figure per employee for the United States was 13,700 tons annually, or 7.5 tons per hour. At Washington commercial sand and gravel operations, the average output per man annually was 14,300 tons, or 9.6 tons per hour. Output per employee exceeded 20,000 tons at several sand and gravel operations in the Area in 1964, and for two large operations, the figure exceeded 40,000 tons. Comparing the information presented in Table 40 over the period 1958-63, indicates that each year productivity could increase about 0.1 ton per man per hour in the United States. Output per man would about double in 50 years based on this trend of available information.

TABLE 40. Average sand and gravel output per man per hour at commercial operations,1958-64 (short tons)

Year	Washington	California	United States
1958	10.9	9.6	6.9
1959	9.8	8.9	6.8
1960	9.4	9.6	7.4
1961	9.8	9.9	7.4
1962	10.0	10.0	7.5
1963	9.6	11.5	7.5
1964	NA	NA	NA

NA Not available.

Available information also was compiled for employment at commercial and Government-and-contractor sand and gravel and stone operations in the United States, Washington, and California, Table 41. The data show that output per employee at stone operations is about one-half that of sand and gravel operations, or ranges from 7,500 tons to about 9,800 tons per employee. In Washington, the average employee output at stone operations ranged from 7,800 tons in 1963 to 9,700 tons in 1964. Several large commercial stone operations in the Area reported output of over 18,000 tons per man in 1964. From all sand and gravel operations in Washington, employee output is slightly larger than for commercial operations only; many Government-and-contractor operations supply sand and gravel from bank-run material, thereby cutting down on labor and processing equipment. Sand and gravel employment estimates for the Puget Sound Area are based on the State average at commercial operations, or about

TABLE 41. Total employment at commercial and Government-and-contractor operations, 1963-64

	Washington		United States		California	
	Sand and Gravel	*Stone*	*Sand and Gravel*	*Stone*	*Sand and Gravel*	*Stone*
Employment:						
1963	1,382	1,332	52,804	91,960	5,462	5,031
1964	1,940	1,320	55,400	94,600	5,465	4,675
Production: (thousand tons)						
1963	22,760	12,934	821,850	688,366	112,185	37,977
1964	31,920	10,276	868,779	725,269	112,995	45,805
Output per man: (short tons)						
1963	16,468	9,710	15,564	7,485	20,539	7,548
1964	16,453	7,784	15,681	7,667	20,676	9,797

15,000 tons per employee. Stone estimates are based on output of 7,500 tons per employee. It seems reasonable to assume that future efficiency of sand and gravel and stone operations will improve, particularly near expanding centers of population. Productivity, in terms of output per employee, has been projected to double or reach 30,000 tons for sand and gravel and 15,000 tons for stone by 2020 at sand and gravel and stone operations near large population centers in the Central economic subarea. Productivity has been estimated to remain constant throughout the period of this study at operations supplying aggregates in the Northern and Western economic subareas with low population densities.

Employment by the cement industry could be reduced sharply, possibly by as much as one-half of 1964 employment by 1980. Output in 1964 was from established plants in the Area, and output per man is estimated to be about 12,500 barrels. Firm commitments have been made by cement operators to construct highly efficient cement manufacturing capacity of 8.5 million barrels before 1970. If plans for additional cement facilities in the Area are realized, output per man from the new plants can be expected to reach about 28,000 barrels. It is assumed that some of the established plants in the Area will remain operational and will take up the employment slack between committed operations. Employment projections for cement and lime operations, therefore, are held constant to 2000 when additional cement and lime plant expansion possibly will necessitate additional employment in manufacturing these materials.

Employment at miscellaneous nonmetals, and coal, peat, petroleum exploration, and metal mining operations is not expected to be over 300 men by 2020. Present employment at operations supplying these minerals is less than 300 men. In the absence of dependable information to the contrary, projections for these commodities are held constant with 1965 figures. Estimated mining employment is shown by subregion in Table 42.

The estimated cost of labor at some mining operations in the Puget Sound Area is shown in Table 43. About 50% of the total value of sand and gravel or $0.53 per ton was labor cost. The unit cost of labor at stone operations averaged $0.92 per ton, or comprised 54% of the total value for these materials. Labor costs for cement, averaging $0.62 per barrel, comprised 18% of the total value.

TABLE 42. Mining industry employment by subarea, 1980-2020

Economic Subarea	1980	2000	2020
Central	1,430	1,750	2,015
Northern	580	625	675
Western	140	175	210
Total Area	2,150	2,550	2,900

TABLE 43. Estimated cost of labor at mining operations in the Puget Sound Area, 1964

	Sand and Gravel	Stone	Cement
Production[1]	12,357	3,484	4,292
Value (thousand dollars)	$11,592	$5,936	$15,721
Unit value (dollars per ton)	$1.07	$1.70	[2]$3.66
Wages	$5,800	$3,200	$2,800
Percent of total value	50	54	18
Unit cost of labor (dollars per ton)	$0.53	$0.92	[2]$0.62

[1] Production of sand and gravel and stone is 1,000 short tons; cement is 1,000 barrels.

[2] Dollars per barrel.

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Exhibit D
Economic Study of Puget Sound and Adjacent Waters

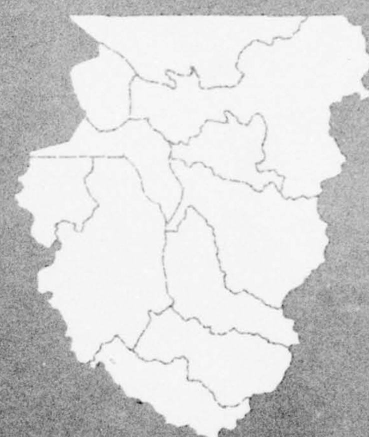

EXHIBIT D

ECONOMIC STUDY
OF THE
PUGET SOUND AND ADJACENT WATERS AREA

PROJECTIONS 1980 — 2000 — 2020

Prepared for
PUGET SOUND TASK FORCE of the PACIFIC NORTHWEST
RIVER BASINS COMMISSION

By
Consulting Services Corporation
Seattle, Washington

January 1968

PREFACE

The Comprehensive Water Resource Study of the Puget Sound and Adjacent Waters area has been undertaken by a Task Force of the Columbia Basin Interagency Committee now replaced by the Northwest River Basin Commission. This report on the region's economy and its projected growth joins with other studies to provide the factual basis for the development of overall water resource development plans. Water resource development affects many aspects of the area's economy. Therefore this study reports in some detail on the present and projected levels of economic activity of the area. Thus, it is fair to claim that it will be of value to other individuals and groups.

The Puget Sound and Adjacent Waters area consists of the 12 counties in northwestern Washington that touch Puget Sound. The two major industries are aerospace, led by The Boeing Company located in the Seattle area, and forest products spread throughout the area. Oceanborne commerce, commercial and sports fishing and general recreation also stimulate the area's economy. These latter activities are the results of the geographical characteristics of the area with protected deepwater harbors, 20 major and minor river basins and a wealth of scenic values in forested mountainous setting.

The present study examines the area's economy and asks: Where are we and where are we going? Such a look utilizes an input-output analysis of the industries in the area: their present and projected relations with markets outside of the area and their present and projected relation to each other. Because planning requires attention to specific places, the study also analyzes and projects economic activity for three divisions of the overall study area.

Looking ahead to 1980 and beyond to 2000 and 2020, the results indicate substantial growth: Gross Regional Product over a 1963 base, to double by 1980; population to over eight million in 2020; employment growing faster than the national rate; and—enough, we would like the report read, at least the summary.

This report has use in long range private and public investment planning as well as for water resource planning. Private planning requires estimates of expected market size. Although added details are usually needed, this study provides background control totals as a benchmark for more detailed plans for projects and the relationship between these projects.

A final comment is in order. Our methodology, albeit technical at times, has the advantage of allowing the interested reader to follow the steps involved. Since information is always less than desired, we do, indeed, encourage comments and suggestions.

Jack Harbeston
Consulting Services Corporation

EXHIBIT D

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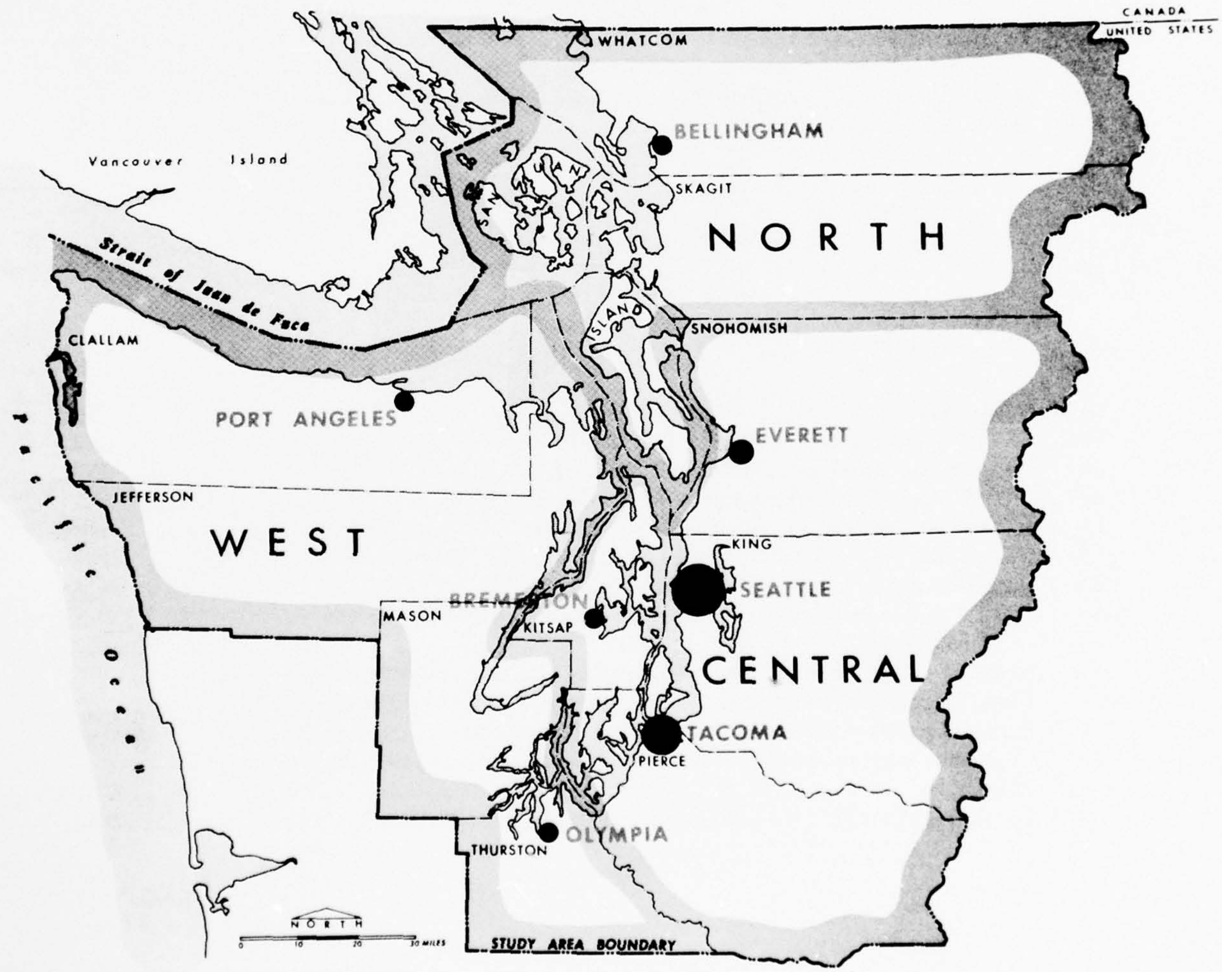
STUDY REGION
AND
DIVISIONS

figure I-1



CHAPTER I
STUDY SUMMARY

This summary of the economic study of the Puget Sound and Adjacent Waters (PS&AW) area consists of four components. Simply put, the components answer these questions:

1. What is the area like now?
2. How was the projection made?
3. What are the major findings?
4. Finally—are the findings reasonable?

THE AREA AND ITS DIVISIONS

The area, shown in Figure I-1, contains 12 counties in northwest Washington, all bordering on Puget Sound and Adjacent Waters. Three divisions, the North, Central and West and the counties they include, are also identified in Figure I-1. In brief, the area consists of about 15,000 square miles of which some 2,500 is of landlocked salt water. With a good deal of the land being mountain forests, the major population centers are clustered along the waterfronts in urban places such as Bellingham, Everett, Seattle, Tacoma, Olympia, Bremerton, and Port Angeles. Running down from the snow capped Olympic and Cascade mountain ranges are 10 major and 10 minor rivers.

Currently some two million people reside in the area—about two-thirds of the state's population. The vast majority, about 9 out of 10, live in the Central division dominated by Seattle.

In such a physical environment the forest products industry (consisting of the lumber, wood, paper and allied products industries) looms as the second major manufacturing industry—second only to transportation equipment which includes aircraft. As Table I-1 shows for the base year of this report, 1963, employment in the two industry groups far exceeds employment in all other manufacturing industries combined. Other economic indicators of the area's position in 1963 are shown in Table I-2. Gross Regional Product stands at $5.8 billion. (This compares with a $9.1 for the state). The largest single market for the area's output is its own consumers with purchases of $2.3 billion. The Federal Government purchased $1.4 billion.

TABLE I-1. Total employment, 1963: (in 000's)

No.	Industry	1963 Employment
1	Agri., For., Fish & Mining	23.7
2	Food & Kindred Products	15.9
3	Lumber & Wood Products	19.7
4	Paper & Allied Products	9.4
5	Chemicals	2.3
6	Petroleum Refining	1.2
7	Stone, Clay & Glass	3.8
8	Primary Metals	4.1
9	Other Non-Durable Mfgrs.	15.1
10	Other Durable Mfgrs.	86.2
11	Trans., Com., & P.V.	40.2
12	Whsle. & Retail Trade	140.0
13	Services	144.0
14	Construction	41.2
15	Government	115.8
	Total	662.6

Note: Underlined industries are large water users.

TABLE I-2. Selected economic indications, 1963: Puget Sound and Adjacent Waters

Indicator	Magnitude
Population	1.9 million
Total Employment	662.6 thousand
Gross Regional Product	$5.8 billion
Output Sold to:	
Federal Government	$1.4 billion
World Trade	$ .2 billion
U.S. Markets (Outside PS&AW)	$1.8 billion
Consumers	$2.3 billion

Output sold to other areas was valued at $1.8 billion. A smaller, but growing world trade market approximated $.2 billion.

Regional and U.S. population from 1900 to 1960 are shown in Table I-3. Since 1900 the area's share of U.S. population has risen from .33 percent to almost 1.0 percent in 1960 (Figure I-2). Regional personal income data, available only for selected years from 1929, also indicates a growing share of national activity (Figure I-3). Since World War II

SEATTLE WATERFRONT, Port of Seattle Photo

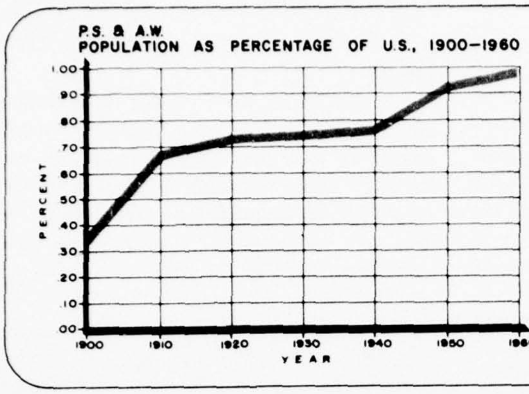


figure I-2

TABLE I-3. Population growth-Puget Sound and Adjacent Waters and U.S.: 1900-1960

Year	PS&AW Population (000's)	U.S. Population (millions)
1900	264.5	76.1
1910	607.2	92.4
1920	772.5	106.5
1930	909.9	123.2
1940	1,007.1	132.1
1950	1,418.4	151.7
1960	1,768.1	180.7

figure I-3

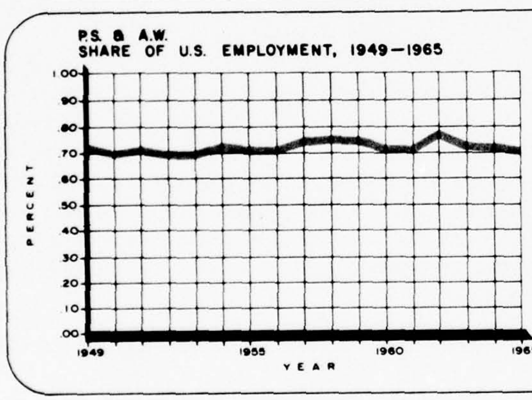


figure I-4

employment in the area has moved, with some hesitations upward, although the share of national employment has remained fairly constant (Figure I-4). This upward trend in employment share would show up more pronounced in Figure I-4 if more recent comparable data were available. In the past few years, led by aerospace and aluminum, the area has experienced a sharp upturn in activity.

Within the area, the relative distribution of the population has remained unchanged, again dominated by the Central Area (Figure I-5). Since World War II, value added by manufactures has shown a steady, of not heroic increase (Figure I-6). Employment in 1963 in each Division is shown in the first entry of the Division columns of Table I-4. The north tends to specialize in forest products, food and kindred products and petroleum refining while forest products dominate the West. The Central, while containing forest products and a smattering of other industries, is heavily oriented to aerospace and other transportation equipment.

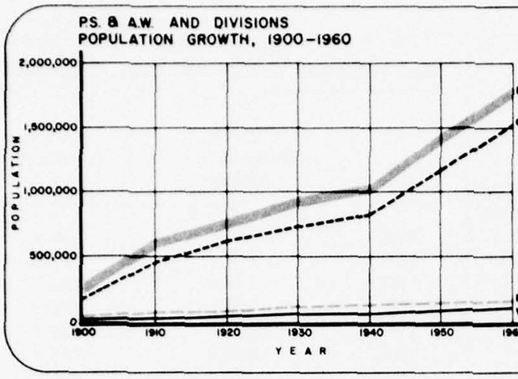


figure I-5

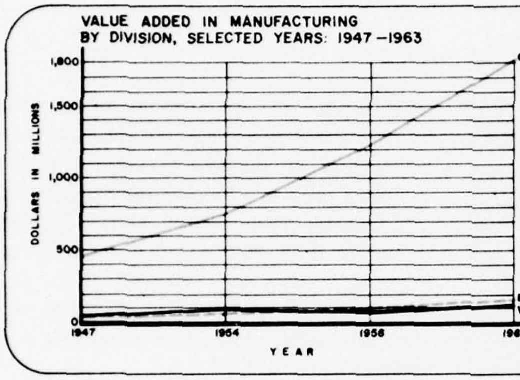


figure I-6

PROJECTION METHODOLOGY

The method utilized in projecting economic activity to 1980, 2000 and 2020, is known as input-output analysis. This relatively new technique in regional analysis not only examines the present, but provides a tool for viewing the future. In terms of data gathering, the chore is so formidable many researchers back off. Yet beneath the morass of details lie some steps that are simple to follow.

A State of Washington input-output table for 1963, developed by field surveys of industries, was modified to describe the PS&AW economy. For each and every industry in the area–from agriculture through manufactures, services and the like–this table shows its sales of output to: (1) every other industry in the area; (2) local consumers, local investors and local governments; and (3) sales to the Federal Government, other areas of the U.S. and to world markets. The sales to other industries in the area of course, represent purchases by these industries. These relationships tell the influence of output changes in one industry on its suppliers and the suppliers, in turn, on their suppliers.

Changes in the demands of local consumers, investors and governments by and large depend upon their incomes; in the case of local governments, it is the size of the total regional income. Demands outside the area are more basic. For example, the current upswing in economic growth of the area in large part reflects the ability of aerospace to sell to: buyers in other areas; the Federal Government; and to foreign nations. In fact, if we knew what would happen to the markets outside the area in the future, sales outside the area could be projected. In turn, we could be sure the local serving industries would follow along. This is known as the export base approach.

Happily, national projections of Federal demand, world trade exports and output levels in other areas in 1980 were available or could be developed. By knowing present ties to these markets and given their projected growth, a projection of the PS&AW sales outside the area was generated. These, in turn, were fed through the framework or model in order to examine the impact on local serving industries.

In the projection process, account was taken of: changes in technology, expected local production of goods now imported into the area, productivity increases; labor force participation rates; the changing pattern of consumer behavior as per capita incomes increase; and the emergence of new industries. Further care was taken not to project output greater than available supply conditions warrant, such as in forest products.

SUMMARY OF FINDINGS: PROJECTIONS TO 1980, 2000 AND 2020

Even a casual inspection of the accompanying Table I-4 which summarizes the projections indicates a substantial growth in population and economic activity. A few highlights are mentioned.

TABLE I-4. 1963 and projected employment by major industry, population and gross regional product for the Puget Sound Area and divisions (employment in 000's)

No.	Employment by Industry	North Division 1963	North Division 1980	North Division 2000	North Division 2020	Central Division 1963	Central Division 1980	Central Division 2000	Central Division 2020	West Division 1963	West Division 1980	West Division 2000	West Division 2020	Puget Sound Regional Total 1963	Puget Sound Regional Total 1980	Puget Sound Regional Total 2000	Puget Sound Regional Total 2020
1	Agri., For., Fish., & Mining	7.1	6.0	5.3	4.7	14.0	9.9	6.6	4.8	2.6	2.3	1.6	1.5	23.7	18.2	13.5	11.0
2	Food & Kindred Products	2.4	2.2	2.5	2.8	12.6	15.9	18.7	21.0	.9	1.4	1.6	1.8	15.9	19.5	22.9	25.6
3	Lumber & Wood Products	2.1	1.5	.4	.1	13.1	5.2	1.8	.6	4.4	1.7	.6	.2	19.7	8.3	2.8	.9
4	Paper & Allied Products	1.1	2.3	2.5	2.0	6.8	8.5	9.3	7.2	1.5	3.8	4.1	3.2	9.4	14.7	15.9	12.4
5	Chemicals	*	*	*	*	2.2	1.8	1.3	.9	.1	*	*	*	2.3	1.9	1.4	1.0
6	Petroleum Refining	1.0	1.2	1.2	1.2	.2	.2	.2	.2	*	*	*	*	1.2	1.3	1.4	1.3
7	Stone, Clay & Glass	.4	.5	.7	.8	3.3	4.5	5.8	7.1	.1	.1	.1	.1	3.8	5.0	6.5	8.0
8	Primary Metals	*	3.5	4.2	4.8	4.1	3.8	4.5	5.1	*	*	*	*	4.1	7.3	8.7	9.9
9	Other Non-Durable Mfgrs.	.7	.5	.7	.8	13.8	19.0	24.3	29.8	.5	.2	.3	.3	15.1	19.7	25.2	30.9
10	Other Durable Mfgrs.	.8	1.3	2.8	5.9	85.2	174.0	377.1	780.1	.2	.3	.7	1.5	86.2	175.7	380.7	787.4
11	Trans., Com., & P.V.	2.1	2.7	2.3	1.8	36.7	32.1	26.3	20.6	1.5	1.4	1.2	.9	40.2	36.2	29.7	23.3
12	Whsle. & Retail Trade	8.3	11.1	16.0	22.0	125.3	187.0	269.8	371.5	6.3	4.5	6.5	9.0	140.0	202.6	292.3	402.4
13	Services	8.4	10.0	16.9	27.3	128.3	214.2	362.0	584.0	7.3	5.9	9.9	16.0	144.0	230.1	388.8	627.3
14	Construction	2.8	2.8	3.7	4.5	36.3	49.6	64.2	79.4	2.1	2.0	2.7	3.3	41.2	54.5	70.5	87.2
15	Government	8.3	12.3	19.0	28.0	97.2	147.5	227.9	336.1	10.2	18.3	28.3	41.7	115.8	178.1	275.1	405.8
	Total Employment	45.5	57.9	78.2	106.7	579.1	873.2	1399.8	2248.4	37.7	41.9	57.6	79.5	662.6	973.1	1535.4	2434.4
	Total Population	151.0	185.5	249.9	341.5	1603.0	2418.9	3882.1	6235.5	116.0	122.5	169.5	232.4	1870.0	2726.9	4300.5	6809.4
	Gross Regional Product (millions 1963 $'s)	369	848	1,800	3,977	5,172	10,022	24,569	62,061	290	498	1,066	1,329	5,830	11,358	27,436	68,248

Note: Underlined industries are large water users.

*Less than 50 employees.

Figures may not add to totals due to rounding.

By 1980:

1. Population is projected to increase over the 1963 figure by about one million to some 2.7 million.

2. Gross Regional Product will almost double, to $11.4 billion and in 1963 dollars!

3. Employment will rise to approximately one million jobs.

4. Gross Regional Product per person, will be up some 34 percent over the 17 year period. This corresponds, just about, to the U.S. past history of increases in Gross National Product per person.

5. In terms of percentage increase, the North Division is projected to show the largest increase in economic activity with aluminum, petroleum refining and education industries leading the way.

6. The present economic upsurge in the Central Division will continue with aerospace leading the industrial activity.

7. The West Division's growth, although slightly less than the Central's rate, draws major strength from the growth of the pulp and paper industry and of State Government in Thurston County.

By-passing the year 2000 and observing 2020:

1. Population will pass 6.8 million people creating a Pugetopolis.

2. Gross Regional Product in 1963 dollars is projected at $68 billion.

3. Employment is estimated at 2.4 million.

4. Gross Regional Product per person is anticipated to climb over the $10,000 mark representing a compound growth rate of about 2.0 percent per year over the 1963 base.

5. The largest growth is still projected for the Central Division, with population estimated at over six million, yet the North is projected to pass the 300 thousand mark and the West will approach a quarter million people. Naturally, these are subject to some revision if major physical changes occur such as a cross-Sound bridge.

6. With respect to the growth of specific industries, some of the projections when extended to 2020 may contain a wee bit of error. All we have projected are the trends. Clearly new products and services not yet know or perhaps even dreamed of will emerge. Thus, a strict interpretation along conventional industry lines makes little sense.

STUDY IMPLICATIONS AND CREDIBILITY OF FINDINGS

For planning purposes some feel for the credibility of these estimates is necessary. While no neat statistical tests of probable errors are available, some of the long-term implications of the findings can be noted.

1. Over the 57 year projection period, the area's share of both population and Gross National Product amounted to about 1.45 percent of the United States projected figures for population and Gross National Product. This represents about a 45 percent increase in the area's share of United States activity. The past trends in the area's share of United States population shown in Figure I-2 Gross Regional Product figures are not available suggest that the overall magnitudes are consistent. This is especially so when the movement toward large urban areas is noted. To be sure, the estimates may be conservative.

2. Increased Gross Regional Product per capita was derived on the basis of increased productivity. The overall average over the 57 year period is just under two percent per year (compounded). This is entirely consistent with the historical trend for the nation.

3. In terms of 1980 employment, Table I-5 compares this study's projected employment in each industry with that industry's projected employment at the industry's national rate of growth. Overall employment is projected to increase by some 46 percent in this study, compared to only 37 percent on a United States rate basis. Yet, the difference is consistent not only with past experience in the area, but with expected increasing concentration in urban areas.

While these results seem consistent with past experience, none of them were built into the input-output projection framework. In other words they were not forced but emerged as part of the analytical method.

In toto, all projections are, after all, projections. The further out one gets, the further out one gets. Yet, subject to all of the usual caveats, we believe.

TABLE I-5. Employment projected at U.S. growth rates vs. study projections: 1980 (in 000's)

No.	Industry	1963	1980 Study Projections	1980 U.S. Growth Rates	Differences Study Projections Less U.S. Rates
1	Agri., For., Fish & Mining	23.7	18.2	28.7	-10.5
2	Food & Kindred Products	15.9	19.5	18.7	0.8
3	Lumber & Wood Products	19.7	8.3	14.9	-6.6
4	Paper & Allied Products	9.4	14.7	13.9	0.8
5	Chemicals	2.3	1.9	1.9	0.0
6	Petroleum Refining	1.2	1.3	1.1	0.2
7	Stone, Clay & Glass	3.8	5.0	5.2	-0.2
8	Primary Metals	4.1	7.3	3.4	3.9
9	Other Non-Durable Mfgrs.	15.1	19.7	17.9	1.8
10	Other Durable Mfgrs.	86.2	175.7	108.5	67.2
11	Trans., Com., & P.V.	40.2	36.7	34.1	2.6
12	Whsle. & Retail Trade	140.0	202.6	200.1	2.5
13	Services	144.0	230.1	253.5	-23.4
14	Construction	41.2	54.5	47.7	6.8
	Total (Excludes Government)	546.8	795.5	749.6	Net +45.9

Note: Underlined industries are large water users.

CHAPTER II

INTRODUCTION TO GENERAL REPORT

The Puget Sound and Adjacent Waters (PS&AW) area consists roughly of those counties in Washington bordering on the Puget Sound or adjacent waters. Largely for data availability purposes, the overall area has been split into three divisions, the North, Central and West. Both the overall area and the three divisions were shown in Figure I-1. The North contains Skagit, Whatcom, Island and San Juan counties. The Central consists of Snohomish, King, Pierce, and Kitsap counties. The West comprises Thurston, Mason, Jefferson and Callam counties.

The general task of this study was to project the level of economic activity of the PS&AW area and its divisions to 1980, 2000, and 2020. In the projection process, particular attention was paid to those industries which are heavy users of water in their productive process. The projections are necessary to provide a sound and factual base in the overall planning effort for public and private investment. Perhaps as important as the projections themselves is the method by which they are derived. The input-output framework used in this study has the advantage of being quite explicit; each step and its basis is spelled out. One important consequence is that the input-output approach allows for periodic up-dating as new data develop. Thus, while major attention is addressed to public needs, especially those related to water use, it is expected that this study will find use for other purposes.

The most detailed list of industries examined in this study along with their Standard Industrial Classification (S.I.C.), is shown in Table II-2. (As a help to the reader, a Glossary of Terms follows this general report.) Unfortunately because of problems of disclosure, it is not always possible to reveal details for each industry shown in Table II-2. This is especially the case for the three divisions of the PS&AW area. For this reason a less detailed set of industries are also used in the report. These are shown in Table II-1.

The industries classified as relatively heavy users of water are shown in Table II-1 by underlining. The underlined industries were specified in the contract funding the study. The term, heavy users of water, implies relatively heavy use in the production process, e.g., pulp mills. The term should not be confused with heavy use in water navigation. The latter connotes the need for water as a transport item delivering goods to or from a production site.

The particular economic indicators to be projected are: output, value added, and employment. Since the interest is in real values, all dollar projections were made in terms of 1963 prices. For reasons explained below, 1963 is the base year of this study.

The report consists of five chapters. Chapter III analyzes the current economic situation in the area and the divisions. Chapter IV is a not-too-technical discussion of the methods used to project to 1980, 2000, and 2020. The results for the year 1980 are presented and followed by the projections to 2000 and to 2020 in Chapter V. (For the benefit of impatient readers who want to skip directly to the projections, those sections have also been kept as non-technical as possible). Finally, a Technical Appendix, written primarily for the research analysist, is attached.

In order to avoid continual footnoting of source materials, a brief discussion of the sources of data has been placed at the end of the general report.

TABLE II-1. Puget Sound and Adjacent Waters Broader industry groups

No.	Industry	Standard Industrial Classification	Detailed Industry Number
1	<u>Agri., For., Fish., & Mining</u>	01-14	1-5, 14, 15
2	<u>Food & Kindred Products</u>	20	6-11
3	<u>Lumber & Wood Products</u>	24	16-19
4	<u>Paper & Allied Products</u>	26	21-23
5	<u>Chemicals</u>	28	25,26
6	<u>Petroleum Refining</u>	29	27
7	<u>Stone, Clay & Glass</u>	32	28, 29
8	<u>Primary Metals</u>	33	30-32
9	Other Non-Durable Mfgrs.	21, 22, 23, 27 30, 31, 38, 39	12,13,24 42
10	Other Durable Mfgrs.	19, 25, 34-37	20, 33-41
11	Trans., Com., & P.V.	40-49	43-47
12	Whsle. & Retail Trade	50-59	51
13	Services	60-67, 70-89	52-56
14	Construction	15-17	48-50
15	Government	90-94	Not Applicable

TABLE II-2. Puget Sound and Adjacent Waters detailed industry classification

No.	Industry	Standard Industrial Classification
1	Field Crops, Including Seeds	011, 0142
2	Vegetables, Fruits & Nut Crops	012
3	Livestock & Livestock Products	013, 0142, 072, 0144
4	Special & Miscellaneous Products	019, 02, 073, 074
5	Fishing	09
6	Meat Products	201
7	Dairy Products	202
8	Canning & Preserving	203
9	Grain Mill Products	204
10	Beverage Industries	208
11	Other Foods	205-7, 209
12	Textile Mill Products	22
13	Apparel	23
14	Mining	10-14
15	Forestry	08
16	Logging	241
17	Sawmills	2421
18	Veneer & Plywood	2432
19	Miscellaneous Wood Products	2426, 2429, 2431, 2433, 244, 249
20	Furniture & Fixtures	25
21	Pulpmills	261
22	Paper Mills	262
23	Miscellaneous Paper & Paperboard Mills	263-266
24	Printing, Publishing & Allied Industries	27
25	Industrial Inorganic & Organic Chemicals	281
26	Other Chemicals	282-289
27	Petroleum Refining & Related Industries	29
28	Glass & Cut Stone Products	321-3, 328-9
29	Cement, Clay, Concrete, Gypsum & Plaster Products	324-7
30	Iron & Steel Rolling & Finishing Mills, Foundries & Forging	331-332, 3391, 3399
31	Non-Ferrous Metals—Except Aluminum	3331-3, 334, 3339, 3356, 3357, 3351, 3362, 3369, 3392
32	Aluminum	3334, 3352, 3361
33	"Heavy" Fabricated Metal Products	344
34	"Light" Fabricated Metal Products	341-343, 345-349
35	Non-Electrical Motive & Moving Equipment	351, 352, 353
36	Machine Tools & Shops	354, 359
37	Non-Electrical Industrial Processing Equipment	355, 356, 357, 358
38	Electrical Machinery, Equipment & Supplies	36
39	Aerospace	372
40	Motor Vehicles & Equipment, Railroad Cars	371, 374, 375, 379
41	Shipbuilding & Repairing	373
42	Finished Plastics, Luggage, Instruments, Rubber Products, Advertising Signs, Jewelry, Toys, Sporting Goods	19, 30, 31, 38, 39
43	Railroad Transport, Water Trans., Trans. by Air, Motor Trans., Pipelines & Trans. Services	40, 44, 45, 41-42, 46-47
44	Electric Companies & Systems	491
45	Gas Companies & Systems	492-3
46	Water Supply, Irrigation Systems, Sanitary Services	494-497
47	Communications	48
48	Construction: Plant, Office, Maintenance	part 15, part 17
49	Construction: Highway & Roads	16
50	Construction: Housing	part 15, part 17
51	Wholesale Trade & Retail Trade	50, 52-59
52	Finance	60-62, 67
53	Insurance	62-64
54	Real Estate	65, 66, exclude 656
55	Business Service	73, 81, 861, 862, 89
56	Personal Services	70-72, 75-80, 82-87 (except 861, 862)

CHAPTER III

THE PRESENT ECONOMIC STRUCTURE OF THE PUGET SOUND AND ADJACENT WATERS AREA

The task of projecting an area's economic future begins with the present. Because we are mainly concerned with how the future will differ from the current situation, we begin with consideration of the present economic structure of the PS&AW area.

In this process of review, use will be made of tables and charts developed during the study. They may be somewhat unfamiliar, since they do not come from the ordinary factual sources. However, they do provide new and, hopefully, useful insight into the present structures of the economy of the PS&AW area. In addition, the data are so organized that they can be incorporated into the projections. Additional details as to how the tables were derived are given in later sections of the report. In order to avoid repetition, the tables and charts presented in the first part of Study Summary, Chapter I, have not been repeated. The reader may wish to review these as a background for the more detailed discussion presented below.

First considered in this chapter are some of the overall economic indicators in the area and its three division. Next, attention is paid to the economic inter-relations of various industries in the area. This will serve to show heretofore unknown economic ties between industries and markets. The final section will consider the current economic status of the three divisions. Throughout the discussion, particular attention will be given to the water using industries.

In what follows, frequent reference will be made to the year 1963. Although 1963 antedates this report, it is used as a base year on the grounds of available data. Not only was 1963 the date of the Federal Census of Manufactures and other such censuses, but it was the year chosen for analysis in the State of Washington Interindustry Study, which is used extensively in this report.

THE PRESENT STRUCTURE: AN OVERVIEW

As a refresher from the summary presented earlier, total employment and population in the area and its divisions are shown in Figure III-1. As noted, the Central division containing both the Seattle-Everett Standard Metropolican Statistical Area and the Tacoma Standard Metropolitan Statistical Area, contains the largest number of employees and population.

The distrubution of manufacturing employment in the PS&AW area compared with that of the United States as a whole, is given in Table III-1. It yields a simple story: relative concentration in the forest products and transportation equipment industries.

TABLE III-1. Manufacturing employment by industry—Puget Sound and Adjacent Waters and U.S.: 1963 (In percentages)

Industry Name	Percentage of Total Manufacturing Employment PS&AW	U.S.
Food and kindred products	10.3	10.1
Lumber and wood products	13.2	3.5
Paper and allied products	6.1	3.6
Chemicals	1.5	4.6
Petroleum	.8	1.0
Stone, clay and glass	2.5	3.6
Primary metals	2.6	7.0
Textiles and apparel	2.0	13.3
Furniture and fixtures	1.2	2.3
Printing and publishing	3.9	5.7
Fabricated metals	2.8	6.7
Machinery	4.5	18.4
Transportation equipment	47.2	10.6
Miscellaneous manufacturing	1.4	9.6
Total	100.0%	100.0%

The large dependence on two major industries has resulted in somewhat uneven rate of employment growth. Aerospace, probably moreso in the past then in the present and future, has depended somewhat on Federal contract awards. The forest products industry is also tied, in part, to a somewhat volatile market: housing. Naturally, these industries can increase as rapidly as they can decline. Currently (May 1967), employment in the aerospace industry is over 90,000 in contrast to under 60,000 in 1963 from a total of 73,000 at that time in all transportation industries.

POPULATION AND EMPLOYMENT
PUGET SOUND AND ADJACENT WATERS AND DIVISIONS: 1963
(000's)

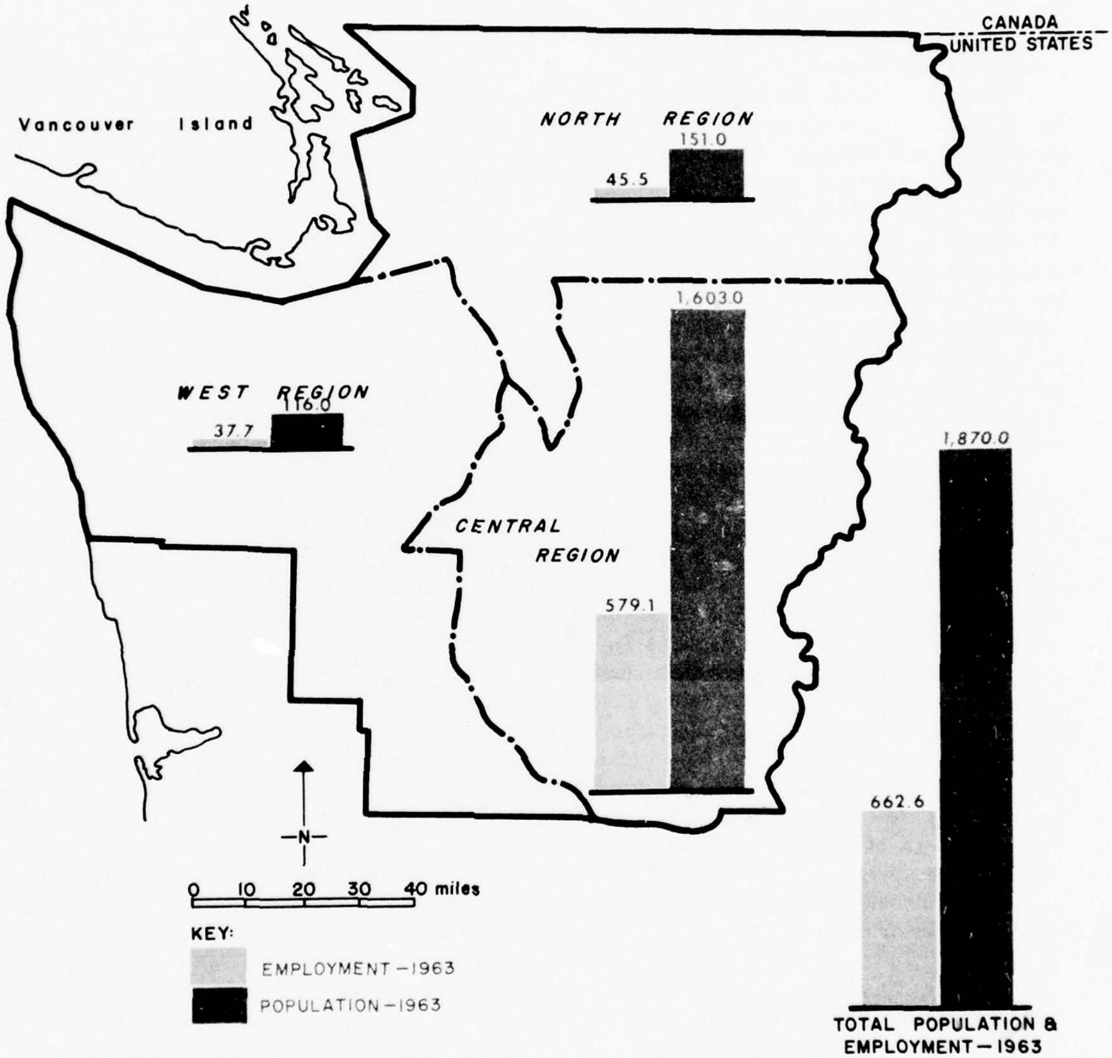


figure III-1

This change is, in no small part, responsible for current upsurge in economic activity.

A more detailed description than is usually available of the industry structure in the PS&AW area is given in Table III-2. Here, each industry's "output" and "value added" for the year 1963, are shown. Why the quotes? As the Glossary explains, the term "output" refers for the most part, to the sales of an industry. However, for some industries—notably retail and wholesale trade—these figures are only "margin" or "markup" entries. Even more important than the output figures, are the value added data. Value added represents wages and salaries, interest payments, rental payments, profits, depreciation, and the like. It is therefore a measure of each industry's contribution to the Gross Regional Product. Hence the term value added, as used here, represents the industry's contribution to Gross Regional Product. This is consistent with the use of the term in the 1958, United States input-putput study published by the U.S. Department of Commerce. The definition of the term does differ slightly, however, from the more familiar concept of value added as used in the various Censuses of Manufactures.

TABLE III-2. Value added and total output—Puget Sound and Adjacent Waters Area, 1963

No.	Industry	(Millions of dollars) Value Added	Total Output
1	Field Crops, including Seeds	1.7	3.2
2	Vegetables, Fruits, & Nut Crops	13.0	19.3
3	Livestock & Livestock Products	29.5	97.7
4	Special & Miscellaneous Products	9.9	15.4
5	*Fishing*	10.4	15.6
6	Meat Products	22.9	138.0
7	Dairy Products	30.0	116.5
8	Canning and Preserving	42.3	120.0
9	Grain Mill Products	12.4	86.6
10	Beverage Industries	56.5	114.2
11	Other Foods	59.2	123.2
12	*Textile Mill Products*	1.5	3.9
13	Apparel	20.8	46.2
14	Mining	10.2	18.9
15	Forestry	24.8	26.6
16	Logging	44.0	96.2
17	Sawmills	57.2	125.3
18	Veneer and Plywood	51.0	126.5
19	*Miscellaneous Wood Products*	22.4	65.7
20	Furniture & Fixtures	15.2	30.5
21	Pulpmills	22.3	59.4
22	Paper Mills	93.4	166.6
23	Misc. Paper & Paperboard Mills	52.4	123.2
24	Printing, Publishing & Allied Indus.	51.5	85.8
25	Industrial Inorganic & *Organic Chemicals*	16.9	21.4
26	Other Chemicals	17.0	49.0
27	Petroleum Refining & Related Indus.	61.5	255.9
28	Glass & Cut Stone Products	9.9	16.6
29	Cement, Clay, Concrete, Gypsum & Plaster Products	28.0	75.7
30	Iron & Steel Rolling and Finishing *Mills, Foundries & Forging*	39.7	60.9
31	Non-Ferrous Metals—except Aluminum	10.7	49.4
32	Aluminum	3.2	8.5
33	"Heavy" Fab. Metal Prods.	34.8	66.0

No.	Industry	(Millions of dollars) Value Added	Total Output
34	"Light" Fab. Metal Prods.	17.6	54.4
35	Non-Electrical Motive & Moving Equip.	26.2	47.0
36	Machine Tools & Shops	16.2	25.1
37	Non-Electrical Industrial Processing Equip.	26.5	46.3
38	Electrical Machinery, Equipment & Supplies	26.7	42.8
39	Aerospace	627.4	1,206.5
40	Motor Vehicles & Equip., Railroad Cars	27.3	81.8
41	*Shipbuilding & Repairing*	141.7	215.3
42	Finished Plastics, Luggage, Instruments, Rubber Prod., Advertising Signs, Jewelry, Toys, Sport. Goods	18.2	32.8
43	Railroad, Water, Air, Motor Trspt., Pipelines, *& Trspt. Services*	223.7	302.3
44	Electric Companies & Systems	83.0	122.5
45	Gas Companies & Systems	10.9	25.7
46	Water Supply, Irrigation Systems, Sanitary Services	10.7	14.2
47	Communications	132.8	150.9
48	Construction: Plant, Office, Maint.	141.6	321.8
49	Construction: Highway & Roads	111.9	294.8
50	Construction: Housing	23.5	57.2
51	Wholesale Trade & Retail Trade	1,011.3	1,250.3
52	Finance	146.0	179.4
53	Insurance	188.4	221.3
54	Real Estate	49.6	78.4
55	Business Service	120.2	157.2
56	Personal Services	338.0	513.2

There is another aspect about the use of the Gross Regional Product concept that should be noted. Gross Regional Product refers to product originating within the area. This is not the same as gross income accruing to residents. For example, rental income received by a PS&AW resident for a house he owns in California is not part of the Gross Regional Product, even if it is part of the income accruing to residents. On the other hand, profits on a local business paid to a New York owner are part of the Gross Regional Product. In general, Gross Regional Product refers to products originating within the area regardless of who ultimately receives the income generated. Why bother to mention such a minute point? Simply to forestall a possible misinterpretation, especially at smaller divisions within the overall PS&AW area. The smaller the area, the greater likelihood that Gross Regional Product will differ from gross income accruing to residents.

It is no surprise that, aside from retail and service industries, the major contributors of output and value added are the aerospace and forest products industries. The overall value added or gross product figure of some $5.8 billion in 1963 constitutes about two-thirds of the State of Washington's gross product of $9.1 billion in the same year. Viewed in this light, about two-thirds of the State's economic activity takes place in the Puget Sound and Adjacent Waters area.

ECONOMIC INTERRELATIONS

The best overall picture of the economic structure of the PS&AW area is given in Table III-3. For the year 1963, the output of each of the industries is shown as serving either other industries in the area or different kinds of markets—consumers, state and local governments, and other markets. By reading across the row, the dollars of output in 1963 can be identified as going to the purchasers listed at the top. The total output of each industry is shown way over in the far right column.

Since one industry's sales to another industry are the latter's purchases, any column shows the amounts purchased in 1963. Of particular interest are the bottom two rows of any column. The value added row reveals the same numbers shown in Table III-2 above—i.e., the contribution of each industry to the Gross Regional Product. The final row indicates imports into the area from foreign nations and from other parts of the United States. (By far the largest source of imports, by the way, are those from other areas of the United States.)

Naturally, caution is needed in interpreting these data. For computer purposes, it is necessary to enter numbers in greater detail than statistical accuracy allows. The output data, for example, were estimated to the nearest 100,000 dollars of output. Thus, no accuracy beyond this amount is implied or even hinted.

In 1963, consumers purchased some $2.3 billion worth of the area's products, indicating the importance of spending by households. Other local sources of demand are represented by investment in plant, equipment, and housing amounting to some $430 million in 1963. State and local governments within the area absorbed $385 million of the area's products.

The area's sales in 1963 to export markets are more vividly illustrated in Figure III-2. Here the exports to the United States market has been broken down into sales going to California and Oregon and sales to the rest of the United States (excluding those two states). As can be seen, the Federal Government accounted for the largest single market while foreign trade was the smallest. (Note, however, that non-governmental exports combined, exceed sales to the Federal Government). The reason for identifying the California-Oregon market is more than recognition of fellow westerners. One of the reasons for a prosperous outlook is due to the fact that California and Oregon are good customers of the PS&AW area. Since their growth, especially California's, is projected to grow at a rate faster than the national average, such growth bodes well for the PS&AW area.

A different way of looking at the structure of the PS&AW economy is shown in Table III-4, a table well worth a moment of exertion. Table III-3 showed that some industry's products are sold to other industries in the area. Yet these are always incorporated in other products. Eventually all products find their way to ultimate users—i.e., to consumers, investors, state and local governments, or the various export markets. In fact all output finally ends up in one or more of the six separate markets—the markets shown in colums 57 through 62 of Table III-3. (These ties can be traced out on the computer by techniques discussed in the next section.) Thus, Table III-4 gives the ties of each industry to the six ultimate markets.

Table III-4 reveals that the largest single market is the local consumer, accounting for some 38% of the total of $7.9 billion of sales. As expected, some

industries, expecially those connected with natural resources, are more often tied only indirectly, through processing industries, to the ultimate markets. Table III-4 also validates the "things aren't what they seem" cliche. For example, the vegetable production industry, Row 2, sells little of its output directly outside the area. Yet, through its ties with other industries, over half the output, $13.2 million, ends up in this market. Such a tracing to various markets provides a useful exercise in marketing and, probably, a few surprises.

The other side of the proverbial coin, where PS&AW industries get their inputs, is also of interest. Table III-5, showing the source of inputs for selected industries, is derived from Table III-3—plus additional information given in the Technical Appendix. Each industry's source of inputs, in percentages, is shown by reading down the industry column. Imports of durables, non-durables, and services are shown at the bottom. (Again, "imports" refers to all purchases from outside the area, not just those from foreign nations.

TABLE III-3. Output flows by industry Puget Sound and Adjacent Waters: 1963 (In producers prices, in millions of 1963 dollars)

(For each PS&AW industry named at the left, reading across the row shows the distribution of output to PS&AW industries and to final markets shown at the top.)

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963

PUGET SOUND AND ADJACENT **WATERS** GROSS FLOWS TABLE 1963

		1 FIELD CROP	2 VEGETABLES	3 LVSTK$PROD	4 OTHER AGRI	5 FISHING	6 MEAT PRODS	7 DAIRY PROD	8 CANN$PRES	9 GRAIN MLLS	10 BEVERAGES
1	FIELD CROP	0.1	-0.0	1.5	-0.0	-0.0	-0.0	-0.0	-0.0	0.8	-0.0
2	VEGETABLES	-0.0	0.4	-0.0	-0.0	-0.0	-0.0	-0.0	15.8	-0.0	-0.0
3	LVSTK$PROD	-0.0	-0.0	4.1	-0.0	-0.0	23.2	50.4	-0.0	-0.0	-0.0
4	OTHER AGRI	-0.0	0.4	-0.0	0.7	-0.0	-0.0	-0.0	1.0	-0.0	-0.0
5	FISHING	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	14.0	-0.0	-0.0
6	MEAT PRODS	-0.0	-0.0	-0.0	-0.0	0.1	5.4	-0.0	0.4	1.4	-0.0
7	DAIRY PROD	-0.0	-0.0	-0.0	-0.0	0.1	0.1	16.6	0.1	-0.0	-0.0
8	CANN$PRES	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	1.1	0.3	-0.0
9	GRAIN MLLS	-0.0	-0.0	30.3	-0.0	0.1	3.8	-0.0	0.6	2.9	-0.0
10	BEVERAGES	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	0.1	-0.0	-0.0	6.5
11	OTHR FOODS	-0.0	-0.0	-0.0	-0.0	0.2	0.4	1.0	2.6	0.8	1.1
12	TEXTILES	-0.0	0.1	-0.0	-0.0	0.2	-0.0	-0.0	-0.0	0.1	-0.0
13	APPAREL	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	1.2	-0.0
14	MINING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
15	FORESTRY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
16	LOGGING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
17	SAWMILLS	-0.0	-0.0	1.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
18	PLYWOOD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
19	OTHER WOOD	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	0.1	-0.0	-0.0	0.3
20	FURN$FIX	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
21	PULPMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	PAPER MLLS	-0.0	-0.0	-0.0	1.3	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
23	PAPBD MILS	-0.0	-0.0	-0.0	-0.0	-0.0	1.1	1.7	3.3	1.6	4.4
24	PRINT$PUBS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	1.1
25	INDUS$CHEM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
26	OTHER CHEM	-0.0	0.2	0.4	0.1	-0.0	-0.0	-0.0	0.1	0.1	0.2
27	PET REFINE	0.2	0.7	1.4	0.6	0.7	-0.0	0.5	0.2	0.1	0.4
28	GLASSSTONE	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	0.5	0.7	-0.0	4.5
29	CEMSCLAY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
30	IRONSSTEEL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
31	NONFER MET	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
32	ALUMINUM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
33	HEAVY METL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	0.2
34	LITE METL	-0.0	-0.0	0.2	-0.0	-0.0	0.9	-0.0	8.7	-0.0	9.6
35	NONELC EQP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
36	MACH TOOL	0.1	0.6	1.3	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
37	NONELC EQP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	-0.0	0.1
38	ELEC MACH	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0
39	AEROSPACE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
40	MOTOR VEH	-0.0	[illegible]	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
41	SHIP BLDG	-0.0	[illegible]	-0.0	-0.0	0.4	-0.0	-0.0	-0.0	-0.0	-0.0
42	OTHER MFGS	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0
43	TRANSPORT	-0.0	-0.0	1.1	0.1	0.2	3.2	3.7	4.2	1.4	3.9
44	ELEC COMPY	-0.0	-0.0	1.2	0.2	-0.0	0.2	0.3	0.4	0.3	0.3
45	GAS COMPY	-0.0	-0.0	-0.0	-0.0	-0.0	0.4	0.4	0.4	0.3	0.2
46	WATER SERV	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	0.1	0.2	-0.0	0.2
47	COMMUNICAT	-0.0	-0.0	0.4	0.1	0.1	0.5	0.3	0.3	0.1	1.2
48	P.O $ MISC	0.1	0.1	1.1	0.1	-0.0	0.5	0.4	0.4	0.4	0.8
49	HOUSING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
50	HIGHWAYS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
51	WHSLE$RET	-0.0	-0.0	1.4	0.1	0.5	3.5	4.2	4.8	1.4	4.1
52	FINANCE	0.2	0.7	8.0	0.5	0.1	0.5	0.3	1.0	0.5	0.6
53	INSURANCE	0.1	0.4	0.9	0.3	0.2	0.5	0.5	1.1	0.6	0.9
54	REA ESTATE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
55	BUSI SERV	-0.0	-0.0	-0.0	0.3	0.6	1.5	1.9	1.6	1.4	1.8
56	PERS SERV	-0.0	-0.0	1.4	0.2	-0.0	0.4	0.6	0.5	0.3	0.5
57	SUBTOTAL	0.8	3.6	55.7	4.7	4.2	46.2	83.7	63.8	16.1	42.9
58	VAL ADDED	1.7	13.0	29.5	9.9	10.4	22.9	30.0	42.3	12.4	56.5
59	IMPORTS	0.7	2.7	12.5	0.8	1.0	68.9	2.8	13.9	58.1	14.8
60	TOTAL	3.2	19.3	97.7	15.4	15.6	138.0	116.5	120.0	86.6	114.2

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963
PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1963

		11 OTHR FOODS	12 TEXTILES	13 APPAREL	14 MINING	15 FORESTRY	16 LOGGING	17 SAWMILLS	18 PLYWOOD	19 OTHER WOOD	20 FURN$FIX
1	FIELD CROP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	VEGETABLES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
3	LVSTK$PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	OTHER AGRI	-0.0	-0.0	0.3	-0.0	-0.0	-0.0	1.4	-0.0	-0.0	-0.0
5	FISHING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	MEAT PRODS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
7	DAIRY PROD	0.9	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
8	CANN$PRES	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
9	GRAIN MLLS	12.2	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
10	BEVERAGES	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
11	OTHR FOODS	5.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
12	TEXTILES	-0.0	-0.0	0.2	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1
13	APPAREL	-0.0	-0.0	2.6	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0
14	MINING	0.2	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
15	FORESTRY	-0.0	-0.0	-0.0	-0.0	0.5	18.4	4.2	1.9	0.4	-0.0
16	LOGGING	-0.0	-0.0	-0.0	-0.0	-0.0	7.8	27.2	15.2	5.4	-0.0
17	SAWMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	3.7	1.7	4.9	1.7
18	PLYWOOD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	6.6	1.8	0.9
19	OTHER WOOD	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	1.1	0.4
20	FURN$FIX	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.4
21	PULPMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	PAPER MLLS	0.3	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
23	PAPBD MILS	3.9	-0.0	0.2	-0.0	-0.0	-0.0	-0.0	0.1	0.1	0.5
24	PRINT$PUBS	1.9	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	0.1	0.1	-0.0
25	INDUS$CHEM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
26	OTHER CHEM	0.2	-0.0	0.1	-0.0	-0.0	-0.0	0.1	6.9	0.1	0.7
27	PET REFINE	0.7	-0.0	-0.0	0.7	-0.0	0.5	0.9	-0.0	0.7	0.1
28	GLASS$STONE	0.6	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	-0.0
29	CEM$CLAY	-0.0	-0.0	-0.0	0.5	-0.0	-0.0	-0.0	0.1	0.1	-0.0
30	IRON$STEEL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.2
31	NONFER MET	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
32	ALUMINUM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
33	HEAVY METL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
34	LITE METL	0.1	-0.0	0.1	-0.0	-0.0	0.1	0.2	-0.0	0.2	-0.0
35	NONELC EQP	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	-0.0	0.1	-0.0	-0.0
36	MACH TOOL	-0.0	-0.0	-0.0	0.2	-0.0	0.1	0.1	0.1	0.1	-0.0
37	NONELC EQP	0.1	-0.0	-0.0	0.2	-0.0	0.2	0.2	0.3	-0.0	-0.0
38	ELEC MACH	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
39	AEROSPACE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
40	MOTOR VEH	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0
41	SHIP BLDG	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
42	OTHER MFGS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1
43	TRANSPORT	4.2	-0.0	0.1	0.4	-0.0	6.8	8.4	3.8	1.5	1.1
44	ELEC COMPY	0.2	-0.0	0.1	0.1	-0.0	-0.0	1.0	0.6	0.2	0.1
45	GAS COMPY	0.5	-0.0	-0.0	0.1	-0.0	-0.0	0.1	0.1	0.1	0.1
46	WATER SERV	0.2	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0
47	COMMUNICAT	0.7	-0.0	0.2	-0.0	0.1	0.4	0.4	0.5	0.1	0.2
48	P.O $ MISC	0.2	-0.0	0.1	-0.0	-0.0	0.1	-0.0	0.1	0.1	-0.0
49	HOUSING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
50	HIGHWAYS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
51	WHSLE$RET	4.3	-0.0	0.4	0.6	-0.0	3.2	6.0	3.7	2.4	1.3
52	FINANCE	0.6	-0.0	0.2	0.1	0.2	0.2	0.3	0.4	0.1	0.1
53	INSURANCE	0.9	-0.0	0.4	0.2	0.3	0.4	1.0	1.0	0.6	0.3
54	REA ESTATE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
55	BUSI SERV	2.2	-0.0	0.4	0.2	0.1	0.3	1.5	1.3	0.7	0.1
56	PERS SERV	0.5	-0.0	0.2	0.1	-0.0	0.4	0.6	0.7	0.4	0.2
57	SUBTOTAL	41.8	-0.0	5.7	3.5	1.2	39.3	57.5	45.4	21.6	8.6
58	VAL ADDED	59.2	1.5	20.8	10.2	24.8	44.0	57.2	51.0	22.4	15.2
59	IMPORTS	22.2	2.4	19.7	5.2	0.6	12.9	10.5	30.1	21.7	6.7
60	TOTAL	123.2	3.9	46.2	18.9	26.6	96.2	125.2	126.5	65.7	30.5

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1963

		21	22	23	24	25	26	27	28	29	30
		PULPMILLS	PAPER MLLS	PAPBD MILS	PRINT$PUBS	INDUS$CHEM	OTHER CHEM	PET REFINE	GLASS$STONE	CEM$CLAY	IRON$STEEL
1	FIELD CROP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	VEGETABLES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
3	LVSTK$PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	OTHER AGRI	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
5	FISHING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	MEAT PRODS	-0.0	-0.0	-0.0	-0.0	-0.0	0.6	-0.0	-0.0	-0.0	-0.0
7	DAIRY PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
8	CANN$PRES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
9	GRAIN MLLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
10	BEVERAGES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
11	OTHR FOODS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
12	TEXTILES	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
13	APPAREL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
14	MINING	-0.0	0.2	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	7.5	0.1
15	FORESTRY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
16	LOGGING	11.2	7.9	2.6	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
17	SAWMILLS	1.7	1.9	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
18	PLYWOOD	0.3	1.0	0.3	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
19	OTHER WOOD	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	0.1
20	FURN$FIX	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
21	PULPMILLS	0.9	5.3	16.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	PAPER MLLS	0.1	0.1	2.6	5.3	-0.0	0.1	0.1	0.1	0.1	-0.0
23	PAPBD MILS	-0.0	2.1	6.3	0.1	-0.0	0.6	0.1	1.1	1.6	-0.0
24	PRINT$PUBS	-0.0	0.1	0.1	1.9	-0.0	0.2	0.1	0.3	0.1	-0.0
25	INDUS$CHEM	0.5	0.2	0.1	-0.0	-0.0	0.4	0.2	-0.0	-0.0	-0.0
26	OTHER CHEM	0.4	1.2	0.7	2.0	0.3	1.3	-0.0	0.4	0.1	0.1
27	PET REFINE	1.0	2.4	1.9	-0.0	0.2	0.4	2.0	-0.0	4.0	-0.0
28	GLASS$STONE	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	0.9
29	CEM$CLAY	1.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	12.6	0.6
30	IRON$STEEL	0.1	0.1	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	0.5	1.2
31	NONFER MET	0.1	-0.0	-0.0	-0.0	-0.0	0.3	-0.0	-0.0	0.1	0.2
32	ALUMINUM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
33	HEAVY METL	0.1	0.1	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	0.3	-0.0
34	LITE METL	0.2	0.1	0.1	0.2	-0.0	0.1	1.2	-0.0	0.4	0.1
35	NONELC EQP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
36	MACH TOOL	0.1	-0.0	-0.0	-0.0	-0.0	0.2	-0.0	-0.0	0.5	0.1
37	NONELC EQP	0.3	0.6	0.2	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0
38	ELEC MACH	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.3	-0.0	0.2	-0.0
39	AEROSPACE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
40	MOTOR VEH	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	0.2	-0.0
41	SHIP BLDG	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0
42	OTHER MFGS	0.1	-0.0	0.1	0.1	-0.0	0.2	-0.0	-0.0	-0.0	-0.0
43	TRANSPORT	2.0	3.4	2.5	0.6	0.3	0.4	5.9	0.3	4.6	1.0
44	ELEC COMPY	0.4	2.1	1.0	0.3	0.8	0.1	1.1	0.2	0.5	1.0
45	GAS COMPY	0.5	2.4	0.9	0.1	-0.0	-0.0	0.1	0.2	0.3	0.5
46	WATER SERV	0.2	0.1	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0
47	COMMUNICAT	0.1	0.4	0.2	0.8	0.1	0.1	0.3	0.1	0.3	0.3
48	P,O $ MISC	0.3	0.4	0.2	0.3	-0.0	-0.0	1.0	-0.0	-0.0	0.4
49	HOUSING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
50	HIGHWAYS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
51	WHSLE$RET	2.3	4.1	3.2	1.0	0.2	0.6	0.3	0.3	2.3	4.2
52	FINANCE	0.3	1.1	0.8	0.5	0.1	0.3	0.7	0.1	0.7	0.4
53	INSURANCE	0.6	1.5	1.1	0.8	0.1	0.4	1.5	0.2	0.7	0.5
54	REA ESTATE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1
55	BUSI SERV	0.3	0.6	0.5	0.9	-0.0	0.3	1.3	0.2	0.3	0.7
56	PERS SERV	0.3	0.8	0.5	3.2	0.1	0.4	3.0	0.2	0.4	0.3
57	SUBTOTAL	25.5	40.3	43.1	18.1	2.3	7.1	19.7	4.0	38.5	12.8
58	VAL ADDED	22.3	93.4	52.4	51.5	16.9	17.0	61.5	9.9	28.0	39.7
59	IMPORTS	11.6	32.9	27.7	16.2	2.2	24.9	174.7	2.7	9.3	8.4
60	TOTAL	59.4	166.6	123.2	85.8	21.4	49.0	255.9	16.6	75.8	60.9

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1963

		31 NONFER MET	32 ALUMINUM	33 HEAVY METL	34 LITE METL	35 NONELC EQP	36 MACH TOOL	37 NONELC EQP	38 ELEC MACH	39 AEROSPACE	40 MOTOR VEH
1	FIELD CROP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	VEGETABLES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
3	LVSTK$PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	OTHER AGRI	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
5	FISHING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	MEAT PRODS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
7	DAIRY PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
8	CANN$PRES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
9	GRAIN MLLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
10	BEVERAGES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
11	OTHR FOODS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
12	TEXTILES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
13	APPAREL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
14	MINING	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
15	FORESTRY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
16	LOGGING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
17	SAWMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	0.1
18	PLYWOOD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.3	0.2
19	OTHER WOOD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	0.1	-0.0
20	FURN$FIX	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	0.1
21	PULPMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	PAPER MLLS	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	0.1	0.2	-0.0
23	PAPBD MLLS	-0.0	-0.0	-0.0	0.4	-0.0	-0.0	0.1	0.2	0.4	0.1
24	PRINT$PUBS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	2.6	-0.0
25	INDUS$CHEM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
26	OTHER CHEM	-0.0	-0.0	0.8	0.2	-0.0	-0.0	-0.0	-0.0	0.5	0.2
27	PET REFINE	0.7	-0.0	0.2	0.1	0.1	-0.0	-0.0	-0.0	0.9	0.1
28	GLASS$STONE	-0.0	-0.0	0.1	0.1	0.1	0.1	-0.0	-0.0	0.2	0.1
29	CEM$CLAY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	-0.0
30	IRON$STEEL	-0.0	-0.0	10.7	0.8	2.6	0.6	0.2	0.2	0.2	5.0
31	NONFER MET	11.5	-0.0	-0.0	-0.0	0.3	0.2	-0.0	0.5	0.3	0.2
32	ALUMINUM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	0.1
33	HEAVY METL	-0.0	-0.0	0.4	0.3	0.2	-0.0	-0.0	-0.0	-0.0	1.0
34	LITE METL	-0.0	-0.0	0.1	2.4	0.6	0.1	0.2	-0.0	1.0	1.0
35	NONELC EQP	-0.0	-0.0	-0.0	-0.0	0.3	-0.0	0.2	-0.0	-0.0	-0.0
36	MACH TOOL	-0.0	-0.0	0.2	0.2	1.3	0.5	0.1	0.1	7.0	-0.0
37	NONELC EQP	-0.0	-0.0	-0.0	-0.0	0.5	0.2	0.7	-0.0	0.1	-0.0
38	ELEC MACH	-0.0	-0.0	0.2	-0.0	0.2	0.1	0.2	0.2	3.4	-0.0
39	AEROSPACE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	15.0	-0.0
40	MOTOR VEH	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.5
41	SHIP BLDG	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
42	OTHER MFGS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	1.9	0.1
43	TRANSPORT	-0.0	0.1	0.3	0.3	0.2	-0.0	0.1	0.1	1.3	0.3
44	ELEC COMPY	0.4	0.4	0.5	0.4	0.2	0.2	0.2	0.2	2.2	0.1
45	GAS COMPY	0.7	-0.0	-0.0	0.2	-0.0	-0.0	0.1	0.1	0.7	-0.0
46	WATER SERV	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	-0.0
47	COMMUNICAT	0.1	-0.0	0.2	0.2	0.1	0.1	0.1	0.2	6.2	0.2
48	P,U $ MISC	-0.0	-0.0	-0.0	-0.0	0.1	0.1	0.1	-0.0	2.1	0.3
49	HOUSING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
50	HIGHWAYS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
51	WHSLE$RET	0.6	0.1	1.2	0.4	0.9	0.5	0.8	0.6	2.7	0.4
52	FINANCE	0.1	-0.0	0.4	0.4	0.1	0.1	0.2	0.1	1.0	0.3
53	INSURANCE	0.3	0.1	0.6	0.5	0.4	0.2	0.5	0.3	2.6	0.6
54	REA ESTATE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0
55	BUSI SERV	0.2	-0.0	0.5	0.4	0.1	0.1	0.5	0.3	5.0	1.2
56	PERS SERV	0.2	-0.0	0.2	0.3	0.2	0.1	0.2	0.2	1.0	0.2
57	SUBTOTAL	15.3	0.7	16.7	7.5	8.5	3.2	4.8	3.5	59.7	12.4
58	VAL ADDED	10.7	3.2	34.8	17.6	26.2	16.2	26.5	26.7	627.4	27.3
59	IMPORTS	23.4	4.6	14.5	29.2	12.3	5.7	15.0	12.6	519.4	42.1
60	TOTAL	49.4	8.5	66.0	54.4	47.0	25.1	46.3	42.8	1206.5	81.8

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1963

		41 SHIP BLDG	42 OTHER MFGS	43 TRANSPORT	44 ELEC COMPY	45 GAS COMPY	46 WATER SERV	47 COMMUNICAT	48 P,O $ MISC	49 HOUSING	50 HIGHWAYS
1	FIELD CROP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	VEGETABLES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
3	LVSTK$PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	OTHER AGRI	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
5	FISHING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	MEAT PRODS	-0.0	-0.0	0.3	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
7	DAIRY PROD	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
8	CANN$PRES	-0.0	-0.0	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
9	GRAIN MILS	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
10	BEVERAGES	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
11	OTHR FOODS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
12	TEXTILES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
13	APPAREL	0.1	0.2	0.1	-0.0	-0.0	-0.0	-0.0	0.4	0.3	-0.0
14	MINING	-0.0	-0.0	0.2	-0.0	-0.0	-0.0	-0.0	0.9	0.7	3.5
15	FORESTRY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
16	LOGGING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
17	SAWMILLS	0.2	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	5.1	12.5	0.2
18	PLYWOOD	0.4	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	1.0	2.4	0.1
19	OTHER WOOD	0.2	0.1	1.3	-0.0	-0.0	-0.0	-0.0	3.0	7.3	0.1
20	FURN$FIX	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.6	0.5	-0.0
21	PULPMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	PAPER MILS	0.1	0.1	-0.0	0.1	-0.0	-0.0	0.3	-0.0	-0.0	-0.0
23	PAPBD MILS	0.2	0.1	0.3	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
24	PRINT$PUBS	0.2	-0.0	0.4	0.3	0.1	-0.0	0.4	0.3	0.2	-0.0
25	INDUS$CHEM	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	-0.0
26	OTHER CHEM	0.8	0.1	1.1	-0.0	-0.0	-0.0	-0.0	1.5	2.6	0.1
27	PET REFINE	0.1	-0.0	22.8	0.7	-0.0	-0.0	0.5	4.0	3.0	2.2
28	GLASS$STONE	0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.6	0.4	0.1
29	CEM$CLAY	0.4	-0.0	0.1	-0.0	-0.0	-0.0	0.1	24.0	15.8	3.6
30	IRON$STEEL	4.0	-0.0	0.4	0.1	-0.0	-0.0	-0.0	4.2	3.9	0.6
31	NONFER MET	0.3	-0.0	-0.0	0.1	-0.0	-0.0	-0.0	0.5	0.3	0.1
32	ALUMINUM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	-0.0
33	HEAVY METL	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	13.2	6.1	1.2
34	LITE METL	1.0	-0.0	0.6	0.2	0.2	-0.0	-0.0	2.0	1.7	-0.0
35	NONELC EQP	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
36	MACH TOOL	0.5	0.1	0.2	-0.0	-0.0	-0.0	-0.0	1.0	0.7	0.2
37	NONELC EQP	0.3	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
38	ELEC MACH	1.2	-0.0	-0.0	0.1	-0.0	-0.0	0.4	0.7	0.3	-0.0
39	AEROSPACE	-0.0	-0.0	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
40	MOTOR VEH	-0.0	-0.0	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
41	SHIP BLDG	0.3	-0.0	0.5	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
42	OTHER MFGS	0.5	1.4	0.1	-0.0	-0.0	-0.0	0.1	0.3	0.1	-0.0
43	TRANSPORT	1.0	0.2	1.4	1.5	-0.0	-0.0	0.1	4.8	3.9	1.6
44	ELEC COMPY	0.4	0.3	1.1	17.8	-0.0	0.1	0.8	0.2	0.1	-0.0
45	GAS COMPY	0.1	0.1	0.4	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
46	WATER SERV	0.1	-0.0	0.1	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	-0.0
47	COMMUNICAT	0.4	0.2	2.8	0.3	0.1	-0.0	1.2	1.6	1.0	0.2
48	P,O $ MISC	0.1	-0.0	8.1	3.0	0.5	0.3	3.1	0.4	0.3	0.1
49	HOUSING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
50	HIGHWAYS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
51	WHSLE$RET	2.6	0.3	5.8	1.2	-0.0	-0.0	0.8	18.6	12.6	1.7
52	FINANCE	0.4	0.2	1.0	0.3	0.1	0.1	0.4	1.6	1.0	0.2
53	INSURANCE	1.4	0.3	3.4	1.1	0.2	0.1	1.4	2.9	1.9	0.4
54	REA ESTATE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.2	-0.0	-0.0	-0.0
55	BUSI SERV	3.0	0.6	3.4	2.0	0.3	0.1	1.5	10.9	3.9	2.3
56	PERS SERV	0.5	0.2	6.4	0.5	0.1	0.1	0.6	1.3	0.7	0.2
57	SUBTOTAL	22.0	4.6	64.1	29.3	1.6	0.9	12.0	105.7	84.3	18.7
58	VAL ADDED	141.7	18.2	223.7	83.0	10.9	10.7	132.8	141.6	111.9	23.5
59	IMPORTS	51.6	10.0	14.5	10.2	13.2	2.6	6.1	74.5	98.6	15.0
60	TOTAL	215.3	32.8	302.3	122.5	25.7	14.2	150.9	321.8	294.8	57.2

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1963

		51 WHSLE$RET	52 FINANCE	53 INSURANCE	54 REA ESTATE	55 BUSI SERV	56 PERS SERV	57 SUBTOTAL	58 CONSUMP	59 STAT$LOC	60 FED EXPEN
1	FIELD CROP	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	2.4	-0.0	-0.0	-0.0
2	VEGETABLES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	16.2	2.9	-0.0	-0.0
3	LVSTK$PROD	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	77.7	19.5	-0.0	-0.0
4	OTHER AGRI	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	3.8	9.6	-0.0	-0.0
5	FISHING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	14.1	1.1	-0.0	-0.0
6	MEAT PRODS	-0.0	-0.0	-0.0	-0.0	-0.0	0.3	8.5	89.2	2.1	10.0
7	DAIRY PROD	-C.0	-0.0	-0.0	-0.0	-0.0	0.3	18.2	75.8	3.6	4.4
8	CANN$PRES	-0.0	-0.0	-0.0	-0.0	-0.0	0.5	3.0	14.4	1.4	5.9
9	GRAIN MLLS	-0.0	-0.0	-0.0	-0.0	-0.0	0.5	50.5	8.7	-0.0	3.0
10	BEVERAGES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	7.3	41.0	-0.0	-0.0
11	OTHR FOODS	0.9	-0.0	-0.0	-0.0	-0.0	1.7	13.8	74.9	0.8	4.1
12	TEXTILES	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.8	0.5	-0.0	-0.0
13	APPAREL	-0.0	-0.0	-0.0	-0.0	0.1	-0.0	5.2	11.1	0.1	-0.0
14	MINING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	14.1	0.1	0.2	1.0
15	FORESTRY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	25.4	0.2	-0.0	-0.0
16	LOGGING	-0.0	-0.C	-0.0	-0.0	-0.0	-0.0	77.3	-0.0	-0.0	-0.0
17	SAWMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	35.5	0.5	0.2	0.1
18	PLYWOOD	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	15.4	0.8	0.1	4.1
19	OTHER WOOD	0.7	-0.0	-0.0	-0.0	-0.0	-0.0	15.3	0.7	1.1	3.3
20	FURN$FIX	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	1.8	4.3	0.6	-0.0
21	PULPMILLS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	22.7	-0.0	-0.0	-0.0
22	PAPER MLLS	2.3	-0.0	0.1	-0.0	0.1	0.2	14.0	4.5	0.1	2.1
23	PAPBD MILS	5.9	0.1	0.1	-0.0	-0.0	0.1	36.8	0.7	0.1	0.3
24	PRINT$PUBS	29.3	3.8	2.9	3.8	2.4	4.8	57.9	20.4	0.9	-0.0
25	INDUS$CHEM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	1.7	-0.0	0.1	-0.0
26	OTHER CHEM	-0.0	-0.0	-0.0	0.1	-0.0	0.6	24.3	2.2	0.4	0.3
27	PET REFINE	13.2	0.4	-0.0	2.1	0.3	4.4	76.1	72.1	5.0	10.6
28	GLASS$STONE	0.2	-0.0	-0.0	-0.0	-0.0	-0.0	9.7	1.2	-0.0	0.1
29	CEM$CLAY	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	59.3	4.7	1.0	1.3
30	IRON$STEEL	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	35.7	-0.0	0.1	1.1
31	NONFER MET	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	15.0	-0.0	-0.0	0.4
32	ALUMINUM	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.3	0.1	-0.0	-0.0
33	HEAVY METL	0.4	-0.0	-0.0	-0.0	0.2	0.2	24.8	0.8	0.6	1.9
34	LITE METL	0.3	-0.0	-0.0	-0.0	-0.0	1.9	35.8	1.1	0.1	2.5
35	NONELC EQP	0.2	-0.0	-0.0	-0.0	-0.0	-0.0	1.6	1.5	0.2	1.5
36	MACH TOOL	-0.0	-0.0	-0.0	-0.0	-0.0	0.4	16.0	-0.0	0.3	2.5
37	NONELC EQP	0.3	-0.0	-0.0	-0.0	-0.0	-0.0	4.6	-0.0	0.1	3.6
38	ELEC MACH	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	7.6	1.6	0.2	7.4
39	AEROSPACE	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	15.5	-0.0	0.3	775.4
40	MOTOR VEH	0.8	-0.0	-0.0	-0.0	-0.0	-0.0	2.2	1.1	0.3	0.8
41	SHIP BLDG	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	1.3	5.9	0.5	186.7
42	OTHER MFGS	0.4	0.1	-0.0	-0.0	0.1	0.1	6.0	2.1	0.4	0.9
43	TRANSPORT	14.5	1.5	1.7	0.6	0.6	3.3	104.5	60.6	3.3	13.2
44	ELEC COMPY	17.6	0.7	0.1	1.9	0.3	4.9	63.8	43.5	9.8	4.5
45	GAS COMPY	2.1	0.2	0.4	0.7	0.2	0.3	14.0	8.8	0.9	0.6
46	WATER SERV	1.3	0.1	0.2	0.6	0.1	1.5	5.6	6.5	2.0	-0.0
47	COMMUNICAT	29.3	3.2	1.9	0.7	2.8	9.6	71.0	57.9	6.5	3.8
48	P,O $ MISC	11.4	1.5	0.5	6.3	0.4	10.6	56.4	-0.0	108.2	22.8
49	HOUSING	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	42.5	0.6	-0.0
50	HIGHWAYS	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	51.2	-0.0
51	WHSLE$RET	21.3	1.9	2.1	1.6	2.1	24.2	165.4	972.8	9.7	2.4
52	FINANCE	13.9	9.6	1.4	0.7	1.0	3.6	57.8	104.5	5.9	7.7
53	INSURANCE	9.9	1.0	12.3	1.5	1.4	4.7	68.0	96.7	4.9	-0.0
54	REA ESTATE	16.0	2.5	2.5	3.5	1.6	11.7	38.2	37.7	0.1	-0.0
55	BUSI SERV	18.4	4.3	4.9	3.5	9.2	11.2	108.8	24.2	8.5	0.2
56	PERS SERV	16.1	1.9	0.7	0.8	1.9	17.4	68.2	407.7	3.2	0.4
57	SUBTOTAL	226.7	32.8	31.8	28.4	24.8	119.1	1696.9	2338.7	235.7	1090.9
58	VAL ADDED	1011.3	146.0	188.4	49.6	120.2	338.0	4495.6	600.8	385.0	349.0
59	IMPORTS	12.3	0.6	1.1	0.4	12.2	56.1	1676.6	1143.5	168.0	8.6
60	TOTAL	1250.3	179.4	221.3	78.4	157.2	513.2	7869.1	4083.0	788.7	1448.5

TABLE III - 3
OUTPUT FLOWS BY INDUSTRY 1963

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1963

		61 INVEST	62 EXPORTS	63 TOTAL
1	FIELD CROP	-0.0	0.8	3.2
2	VEGETABLES	-0.0	0.2	19.3
3	LVSTK$PROD	-0.0	0.5	97.7
4	OTHER AGRI	-0.0	2.0	15.4
5	FISHING	-0.0	0.4	15.6
6	MEAT PRODS	-0.0	28.2	138.0
7	DAIRY PROD	-0.0	14.5	116.5
8	CANN$PRES	-0.0	95.3	120.0
9	GRAIN MLLS	-0.0	24.4	86.6
10	BEVERAGES	-0.0	65.9	114.2
11	OTHR FOODS	-0.0	29.6	123.2
12	TEXTILES	0.3	2.3	3.9
13	APPAREL	-0.0	29.8	46.2
14	MINING	-0.0	3.5	18.9
15	FORESTRY	-0.0	1.0	26.6
16	LOGGING	-0.0	18.9	96.2
17	SAWMILLS	-0.0	89.0	125.3
18	PLYWOOD	-0.0	106.1	126.5
19	OTHER WOOD	-0.0	45.3	65.7
20	FURN$FIX	3.4	20.4	30.5
21	PULPMILLS	-0.0	36.7	59.4
22	PAPER MLLS	-0.0	145.9	166.6
23	PAPBD MILS	-0.0	85.3	123.2
24	PRINT$PUBS	-0.0	6.6	85.8
25	INDUS$CHEM	-0.0	19.6	21.4
26	OTHER CHEM	-0.0	21.8	49.0
27	PET REFINE	-0.0	92.1	255.9
28	GLASS$STONE	-0.0	5.6	16.6
29	CEM$CLAY	-0.0	9.4	75.7
30	IRON$STEEL	1.5	22.5	60.9
31	NONFER MET	-0.0	34.0	49.4
32	ALUMINUM	1.4	6.7	8.5
33	HEAVY METL	2.4	35.5	66.0
34	LITE METL	1.0	13.9	54.4
35	NONELC EQP	12.5	29.7	47.0
36	MACH TOOL	1.2	5.1	25.1
37	NONELC EQP	5.2	32.8	46.3
38	ELEC MACH	6.7	25.3	42.8
39	AEROSPACE	-0.0	415.3	1206.5
40	MOTOR VEH	-0.0	77.4	81.8
41	SHIP BLDG	0.5	20.4	215.3
42	OTHER MFGS	2.7	20.7	32.8
43	TRANSPORT	3.5	117.2	302.3
44	ELEC COMPY	-0.0	0.9	122.5
45	GAS COMPY	-0.0	1.4	25.7
46	WATER SERV	-0.0	0.1	14.2
47	COMMUNICAT	-0.0	11.7	150.9
48	P,J $ MISC	132.6	1.8	321.8
49	HOUSING	251.7	-0.0	294.8
50	HIGHWAYS	-0.0	6.0	57.2
51	WHSLE$RET	7.8	92.2	1250.3
52	FINANCE	-0.0	3.5	179.4
53	INSURANCE	-0.0	51.7	221.3
54	REA ESTATE	2.3	0.1	78.4
55	BUSI SERV	-0.0	15.5	157.2
56	PERS SERV	-0.0	33.7	513.2
57	SUBTOTAL	430.7	2076.2	7869.1
58	VAL ADDED	-0.0	-0.0	5830.4
59	IMPORTS	187.3	-0.0	3184.0
60	TOTAL	618.0	2076.2	16883.5

PUGET SOUND & ADJACENT WATERS SALES TO FOREIGN NATIONS, FEDERAL GOVERNMENT, CALIFORNIA-OREGON & THE U.S. LESS CALIFORNIA-OREGON, 1963

(millions of dollars)

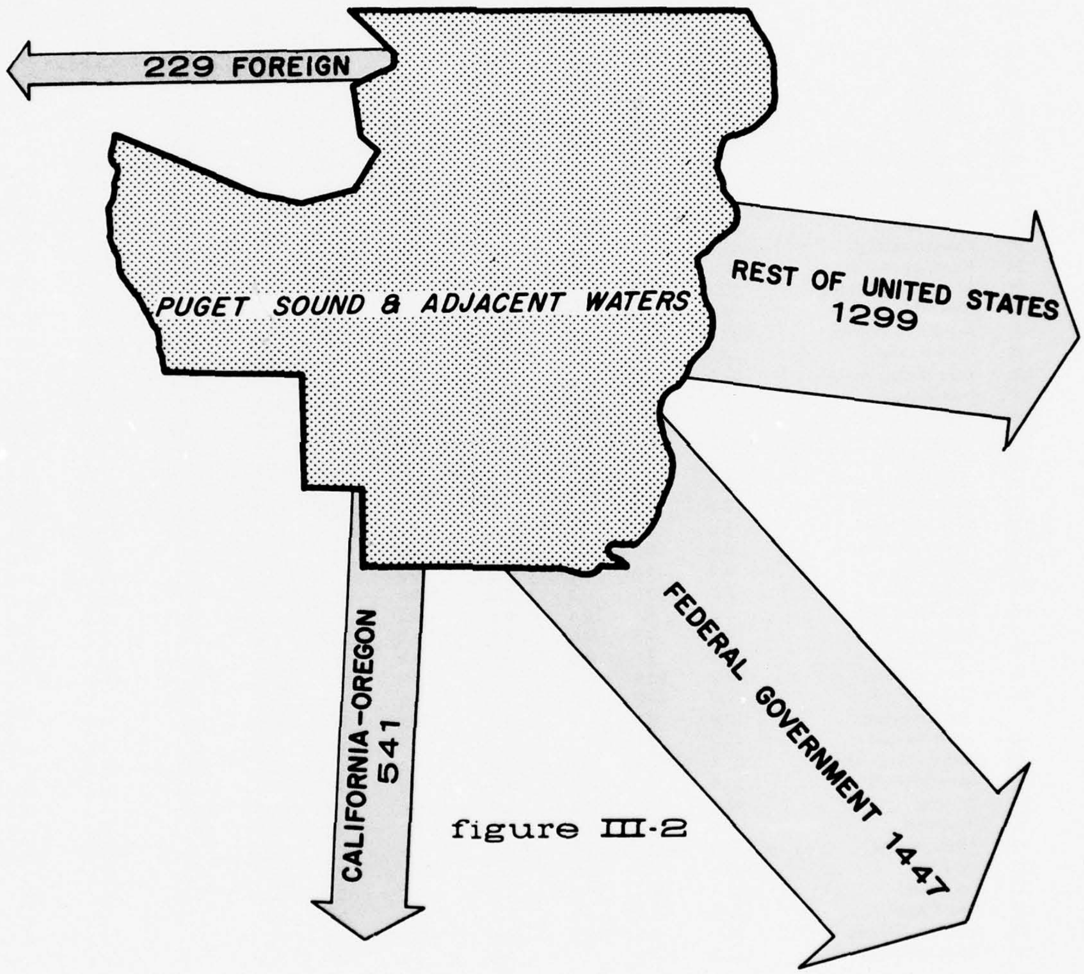


figure III-2

TABLE III-4. Direct and indirect ties to ultimate markets (final demand sectors) Puget Sound and Adjacent Waters, 1963 (millions of dollars)

No.	Name	Consumption Total	Consumption Direct	State and Local Government Total	State and Local Government Direct	Federal Government Total	Federal Government Direct	Investment Total	Investment Direct	Exports Total	Exports Direct	Total Output
1	Field Crops	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.8	3.2
2	Vegetables	5.1	2.9	0.2	0.0	0.8	0.0	0.0	0.0	13.2	0.2	19.3
3	Livestock & Prod.	77.3	19.5	2.3	0.0	4.2	0.0	0.0	0.0	13.9	0.5	97.7
4	Other Agriculture	10.4	9.6	0.0	0.0	0.1	0.0	0.2	0.0	4.7	2.0	15.4
5	Fishing	2.9	1.1	0.2	0.0	0.7	0.0	0.0	0.0	11.8	0.4	15.6
6	Meat Products	94.1	89.2	2.2	2.1	10.6	10.0	0.1	0.0	31.0	28.2	138.0
7	Dairy Products	89.6	75.8	4.2	3.6	5.2	4.4	0.0	0.0	17.5	14.5	116.5
8	Cann. & Pres.	15.7	14.4	1.4	1.4	6.0	5.9	0.0	0.0	96.8	95.3	120.0
9	Grain Mill Prod.	45.6	8.7	0.9	0.0	5.3	3.0	0.0	0.0	34.8	24.4	86.6
10	Beverages	44.0	41.0	0.0	0.0	0.0	0.0	0.0	0.0	70.2	65.9	114.2
11	Other Foods	82.8	74.9	1.0	0.8	4.6	4.1	0.0	0.0	34.8	29.6	123.2
12	Textiles	0.7	0.5	0.0	0.0	0.0	0.0	0.3	0.3	2.9	2.3	3.9
13	Apparel	12.7	11.1	0.3	0.1	0.2	0.0	0.5	0.0	32.5	29.8	46.2
14	Mining	1.8	0.1	5.2	0.2	1.6	1.0	3.9	0.0	6.5	3.5	18.9
15	Forestry	1.0	0.2	0.3	0.0	0.5	0.0	1.5	0.0	23.4	1.0	26.6
16	Logging	3.2	0.0	1.0	0.0	1.6	0.0	4.5	0.0	86.0	18.9	96.2
17	Sawmills	4.7	0.5	2.5	0.2	1.3	0.1	14.1	0.0	102.7	89.0	125.3
18	Plywood	1.8	0.8	0.7	0.1	5.1	4.1	3.0	0.0	115.9	106.1	126.5
19	Other Wood Prod.	3.6	0.7	2.3	1.1	4.0	3.3	7.8	0.0	48.0	45.3	65.7
20	Furniture & Fixtures	4.5	4.3	0.8	0.6	0.2	0.0	4.1	3.4	20.8	20.4	30.5
21	Pulpmills	2.5	0.0	0.1	0.0	0.3	0.0	0.2	0.0	56.3	36.7	59.4
22	Paper Mills	12.4	4.5	0.4	0.1	2.7	2.1	0.3	0.0	150.8	145.9	166.6
23	Paperboard Mills	15.5	0.7	0.8	0.1	1.8	0.3	1.1	0.0	104.0	85.3	123.2
24	Printing & Publish.	62.1	20.4	2.3	0.9	3.0	0.0	1.7	0.0	16.7	6.6	85.8
25	Indus. & Org. Chem.	0.3	0.0	0.1	0.1	0.0	0.0	0.1	0.0	20.8	19.6	21.4
26	Other Chemicals	6.7	2.2	1.3	0.4	2.4	0.3	3.6	0.0	34.9	21.8	49.0
27	Petroleum Refining	103.5	72.1	10.7	5.0	14.3	10.6	7.8	0.0	119.5	92.1	255.9
28	Glass & Stone	4.3	1.2	0.4	0.0	0.6	0.1	0.8	0.0	10.5	5.6	16.6
29	Cem. & Clay Prod.	11.9	4.7	15.2	1.0	4.6	1.3	28.5	0.0	15.5	9.4	75.7
30	Iron & Steel	2.7	0.0	3.4	0.1	6.3	1.1	10.1	1.5	38.5	22.5	60.9
31	Nonfer. Metals	0.4	0.0	0.4	0.0	1.5	0.4	0.9	0.0	46.2	34.0	49.4
32	Aluminum	0.1	0.1	0.0	0.0	0.1	0.0	1.5	1.4	6.8	6.7	8.5
33	Heavy Metals	4.2	0.8	6.4	0.6	3.5	1.9	13.4	2.4	38.4	35.5	66.0
34	Light Metals	11.0	1.1	1.2	0.1	5.2	2.5	4.0	1.0	33.0	13.9	54.4
35	Nonelectric Equip.	1.7	1.5	0.2	0.2	2.0	1.5	12.7	12.5	30.4	29.7	47.0
36	Machine Tools	2.2	0.0	1.1	0.3	8.0	2.5	3.0	1.2	10.8	5.1	25.1
37	Nonelec. Equip.	0.6	0.0	0.2	0.1	4.2	3.6	5.5	5.2	35.8	32.8	46.3
38	Elec. Mach.	2.3	1.6	0.6	0.2	10.9	7.4	1.5	0.7	27.6	25.3	42.8
39	Aerospace	0.2	0.0	0.3	0.3	785.2	775.4	0.0	0.0	420.8	415.3	1,206.5
40	Motor Vehicles	2.0	1.1	0.4	0.3	0.9	0.8	0.1	0.0	78.4	77.4	81.8
41	Shipbuilding	6.2	5.9	0.5	0.5	187.0	186.7	0.5	0.5	21.0	20.4	215.3
42	Other Mfgrs.	3.1	2.1	0.6	0.4	2.8	0.9	3.1	2.7	23.2	20.7	32.8
43	Transport. Serv.	98.2	60.6	9.2	3.3	18.5	13.2	13.6	3.5	162.9	117.2	302.3
44	Elec. Companies	81.0	43.5	12.7	9.8	9.5	4.5	2.1	0.0	17.3	0.9	122.5
45	Gas Companies	13.9	8.8	1.2	0.9	1.6	0.6	0.5	0.0	8.6	1.4	25.7
46	Water Services	10.2	6.5	2.1	2.0	0.3	0.0	0.1	0.0	1.5	0.1	14.2
47	Communications	101.7	57.9	8.8	6.5	9.9	3.8	3.2	0.0	27.4	11.7	150.9
48	Const: P, O, & Mis.	36.4	0.0	109.9	108.2	26.0	22.8	134.4	132.6	15.2	1.8	321.8
49	Housing	42.5	42.5	0.6	0.6	0.0	0.0	251.7	251.7	0.0	0.0	294.8
50	Highways	0.0	0.0	51.2	51.2	0.0	0.0	0.0	0.0	6.0	6.0	57.2
51	Whlse. & Retail	1,040.3	972.8	20.8	9.7	12.1	2.4	31.5	7.8	145.5	92.2	1,250.3
52	Finance	139.7	104.5	8.2	5.9	10.8	7.7	3.0	0.0	17.7	3.5	179.4
53	Insurance	128.0	96.7	8.0	4.9	5.2	0.0	5.0	0.0	75.1	51.7	221.3
54	Real Estate	68.7	37.7	0.9	0.1	0.6	0.0	3.1	2.3	5.1	0.1	78.4
55	Business Services	76.5	24.2	17.1	8.5	9.8	0.2	10.6	0.0	43.2	15.5	157.2
56	Personal Services	449.9	407.7	5.4	3.2	3.5	0.4	3.0	0.0	51.4	33.7	513.2
	Total	3,046.1	2,338.7	328.2	235.7	1,207.2	1,090.9	602.2	430.7	2,685.6	2,076.2	7,869.1

Note: For each industry named at left, the Table shows first the total output tied directly and indirectly to each market. The second entry shows the direct output. The difference represents indirect output.

TABLE III-5. Inputs purchased by industry and geographic source: Selected industries: 1963 (figures in percentages)

Industry Purchased From	Beverage Industries	Paper Mills	Aerospace	Shipbuilding and Repairing	Finished Plastics, Luggage, Instruments, Rubber Products, Advertising Signs, Jewelry, Toys, Sporting Goods	Railroad, Water, Air, Motor, Transport, Pipelines, and Transportation Services
Local Purchases:						
Non-Durables	16.2	15.9	.6	1.5	6.4	9.0
Durables	8.6	.5	2.2	4.0	.3	.8
Services	12.7	10.1	2.0	4.6	7.3	11.3
Value added	49.6	55.8	52.2	66.0	55.6	74.2
Import Purchases:						
Non-Durables	6.2	10.5	7.3	4.7	15.9	2.2
Durables	1.0	1.7	24.6	14.7	10.3	1.6
Services	5.7	5.5	11.1	4.5	4.2	.9
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Figures may not add to totals due to rounding.

THE NORTH, CENTRAL AND WEST DIVISIONS

Turning to the three divisions within the overall area, Table III-6 presents the 1963 employment by industry groups. Also shown is the percentage of the industry total in each area. For the seven heavy water using industries, the distribution of employment is shown more vividly in Figure III-3. Both Table III-6 and Figure III-3 point up the dominance of the Central division; on an overall average it accounts for almost 90 percent of the jobs. It is of interest to note that the dominance is relatively less among the large water using industries. Lumber and wood products and paper and allied products loom relatively large in the North and West divisions. Also, the majority of petroleum refining is in the North. In addition, it should be noted that the recent big upsurge in aluminum output, part of primary metals, had not taken place in the North at the time of the 1963 survey.

Unfortunately, problems of disclosure limit the amount of economic data available for the three divisions. The estimates of employment, for example, had to be built up from various sources of information. Partly for this reason, data showing changes over time are also relatively scarce. Thus, it is not possible to greatly extend the story already presented in Study Summary, Chapter I.

This lack of data is particularly unfortunate in that proper account cannot be taken of the tourist-summer home activity in the North and West divisions. Both the North and West are fortunate in having an abundance of mountain, lake, and salt water recreational sites. While these are also available in the populous Central division, there still is a vast flow in the summer, from the Central to the North and West. Since employment and population data report on where people work and live, they only inadequately catch the economic impact of this flow. In the future, especially with rising per capita incomes, this flow can be expected to increase. Indeed, one of the great challenges to public and private planning in the PS&AW area is how to allow for economic growth without destroying the area's natural amenities.

EMPLOYMENT IN LARGE WATER USING MANUFACTURING INDUSTRIES IN DIVISIONS, 1963
(employment in 000's)

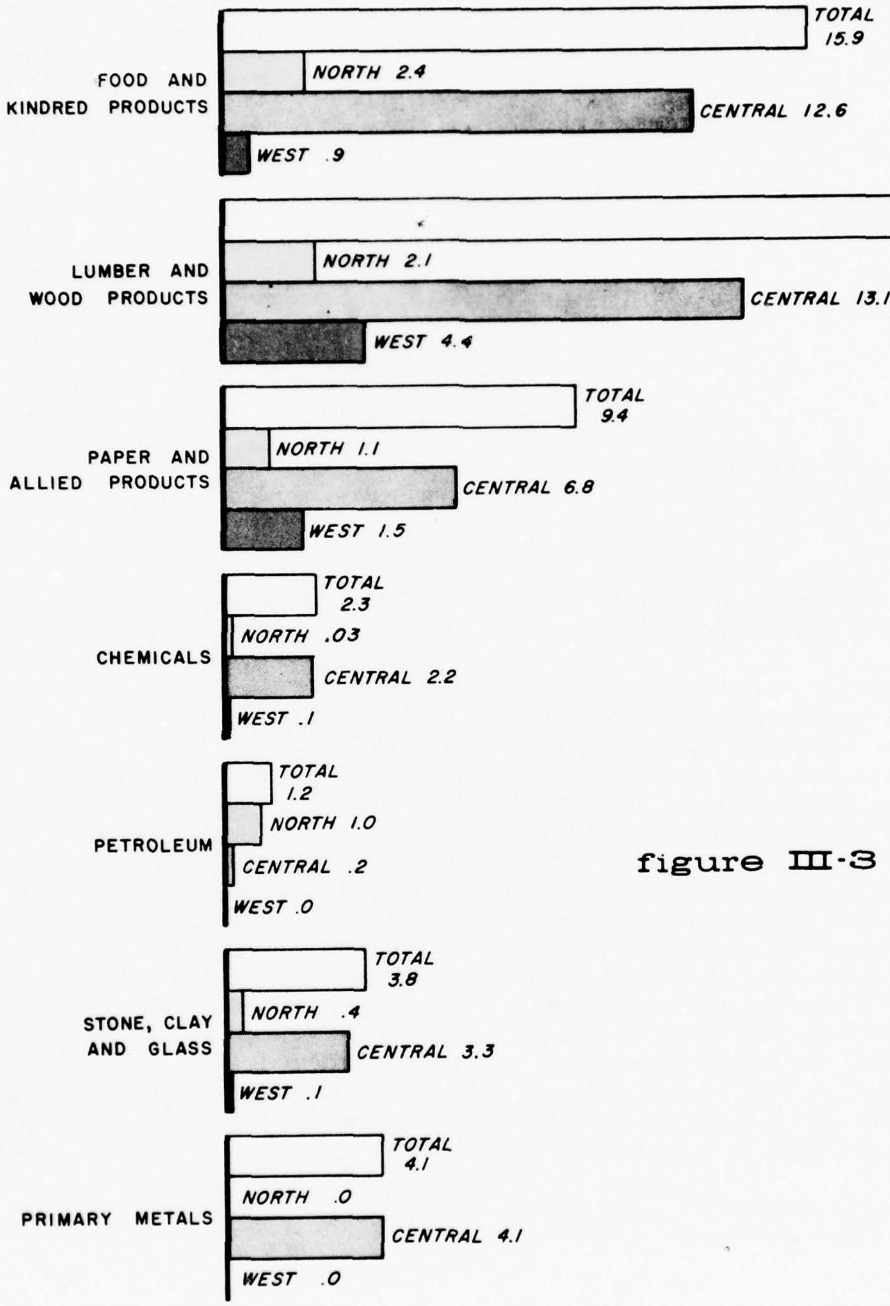


figure III-3

TABLE III-6. Employment by industry in North, Central and West Divisions: 1963

No.	Industry	North Division Employment	North Division Percentage of Total	Central Division Employment	Central Division Percentage of Total	West Division Employment	West Division Percentage of Total	Overall Region Employment	Overall Region Percentage of Total
1	Agri., For., Fish., & Mining	7.1	15.6	14.0	2.4	2.6	6.9	23.7	3.6
2	Food & Kindred Products	2.4	5.3	12.6	2.2	0.9	2.4	15.9	2.4
3	Lumber & Wood Products	2.1	4.6	13.1	2.3	4.4	11.7	19.7	3.0
4	Paper & Allied Products	1.1	2.4	6.8	1.2	1.5	4.0	9.4	1.4
5	Chemicals	*	*	2.2	.4	0.1	0.2	2.3	0.3
6	Petroleum Refining	1.0	2.2	0.2	*	*	*	1.2	0.2
7	Stone, Clay & Glass	0.4	0.9	3.3	0.6	0.1	0.2	3.8	0.6
8	Primary Metals	*	*	4.1	0.7	*	*	4.1	0.6
9	Other Non-Durable Mfgrs.	0.7	1.5	13.8	2.4	0.5	1.3	15.1	2.3
10	Other Durable Mfgrs.	0.8	1.8	85.2	14.7	0.2	0.5	86.2	13.0
11	Trans., Com., & P.V.	2.1	4.6	36.7	6.3	1.5	4.0	40.2	6.1
12	Whsle. & Retail Trade	8.3	18.2	125.3	21.6	6.3	16.7	140.0	21.1
13	Services	8.4	18.5	128.3	22.2	7.3	19.4	144.0	21.7
14	Construction	2.8	6.2	36.3	6.2	2.1	5.6	41.2	6.2
15	Government	8.3	18.2	97.2	16.8	10.2	27.1	115.8	17.5
	Total	45.5	100.0	579.1	100.0	37.7	100.0	662.6	100.0

Note: Figures may not add to totals due to rounding.

*Less than 50 employees.

CHAPTER IV
PROJECTING GROWTH FOR THE PUGET SOUND AND ADJACENT WATERS AREA
THE METHOD IN BRIEF

Projecting the future course of economic events is difficult enough for any regional economy. A dynamic economy like that of the PS&AW area does not make the task any easier. Since some readers and users of this report will not be concerned with the more technical aspects of the projection process, the detailed steps have been remanded to the Appendix. Yet even while avoiding details, a general knowledge of the projection procedure presented here is desirable for purposes of evaluation and utilization.

In order to give the reader a better sense of the discussion that follows, it is helpful to note the questions to which this chapter is addressed. It begins by considering:

1. What are the tasks involved in projecting a regional economy?
2. What framework of analysis is best suited to accomplish these tasks?
3. What are the mechanics of the input-output technique?
4. How was the 1963 PS&AW table constructed?
5. What was the method used to project to 1980 and then trend out to 2000 and 2020?

At the end of this discussion, the reader should be familiar with the why's and wherefore's of the projection method.

THE TASK OF PROJECTIONS

Whether the projection of economic activity levels for the Puget Sound and Adjacent Waters area is an art, a science, or a combination of the two, is not germane to the present task. Yet it is pertinent to note that while the past does yield clues to future events, these clues are often hard to ferret out and interpret. In addition, regional economies are subject to numerous forces beyond the area's control. Changing patterns of defense spending, new technologies, shifting tastes, and movements in transport costs are some of the factors affecting the future of any regional economy. One task of projection is to attempt to identify these forces and their impact upon the area's growth.

A second task is all too often overlooked; a useful projection method should indicate how the projections are developed. It is of little use to have projections which, as it were, come out of a black box, because policy decisions require not only estimates of future activity levels but some analysis as to why these new levels can be expected. Further, as new information develops, the framework for projections should allow these new facts to be incorporated into the projection to modify the results.

FRAMEWORK OF ANALYSIS

Various frameworks of analysis were considered as a basis for projecting the economy of the PS&AW area. In the review of possible frameworks, several requirements were kept in mind. These are:

1. Does the framework rest on sound principles of economic behavior?
2. Are adequate data available to implement the framework?
3. Does the framework allow for periodic updating as new information develops?
4. Will the framework allow for such unique characteristics as exist in the PS&AW area?
5. Can other studies of the area be utilized within the framework, thus bringing greater knowledge and effort to the task?

It must be recognized that no single framework is perfect in all respects. The interindustry or input-output framework emerged as far and away the best for the PS&AW area because it most nearly fits the requirements and can be readily accomplished with data available from recent economic studies.

The major factor in choosing the interindustry framework was the availability of an excellent study done by the University of Washington for the Washington State Department of Commerce and

Economic Development. By modifying and expanding portions of this study, a highly suitable framework and set of data were developed.

Interindustry studies, or input-output studies as they are often called, have received increasing notice in the business analysis community. A table showing the interindustry relations for the United States in the year 1958 appeared in the United States Department of Commerce's Survey of Current Business, November 1964. Since that time the use of this technique has increased considerably for many purposes of economic analysis. For regions, however, the use of the input-output approach is largely in the talking stage, since for most regions, data are not readily available. It is not amiss to repeat that this study was most fortunate in having input-output data available for the State of Washington.

INPUT-OUTPUT ANALYSIS: A BRIEF RUN-THROUGH

At a technical level, input-output analysis can be quite formidable, running the gamut from the solution of simultaneous equations and computer programs to details such as what industry produces the goods sold to a municipal zoo. The general notions, on the other hand, are not too complex. As a matter of fact, perhaps without knowing it, the reader has already been exposed to input-output analysis in many of the tables and charts of the two previous chapters. Since the State of Washington 1963 table was a starting point for this study, it serves as a good place to begin a brief run-through of the technique. (At the same time this will also provide some information on the overall area of which the PS&AW is a part.)

Output Flows

The outputs of 27 Washington industries are shown in Table IV-1 for the year 1963. (This table is a reproduction of one that appeared in The University of Washington Business Review, February 1966.) This table is similar to Table III-3, shown above, for the PS&AW area. As before, reading across the rows indicates that the outputs are sold either to other industries or to what have been labeled as "Final Demands". Thus, reading across the first row one sees that the agricultural industry sold some $80.6 million of its output to the canning, preserving, and milling industry in the state. In addition, agriculture sold some $23.3 million to Washington consumers. Additional sales to $110.3 and $142.5 million were made to other regions and foreign trade, respectively. The total gross output, $396.3 million in 1963, is shown at the far right.

a. Some Conventions Just as with the 1963 PS&AW table shown above, it does no harm to think of industry outputs as the sales of the various industries during the year 1963. There are, however, a few exceptions that should be noted.

The sales of retail and wholesale firms show only the "margin" or "markup" values. As an example of how this works, read across the fourth row, meat and dairy products, sold to the Washington personal consumption expenditures column. The entry $259.2 million shows how much consumers spent on meat and dairy products. Yet back along the fourth row under Column 25, Wholesale and Retail Trade, there is no entry. This does seem unusual. Surely the meat and dairy products industry sold a large volume of its output to wholesale and retail outlets. Do not be misled, this is just an input-output convention; products which pass only through wholesale and retail outlets on their way to final markets are considered as direct sales to these markets. If this were not done, almost all outputs would be shown as going to wholesale or retail.

This convention, however, does not forget the wholesaler and retailer. The $259.2 million paid to Washington consumers for meat and dairy products is in producers' prices, representing the amount the producers received. Consumers actually paid more, because the markup by wholesalers and retailers has to be allowed for. Thus the $1,451.9 million entry in Row 25, Wholesale and Retail Trade, and the Washington personal consumption expenditures column includes this markup or margin on meat and dairy products.

Because there is no obvious equivalent to sales, some other industries such as banking and insurance are also shown as margin entries. Aside from these special cases, however, output and sales amount to just about the same thing.

b. The Treatment of Capital Goods One other point should be noted when reading across the rows to see where outputs go. **Only current inputs appear in the industry-to-undustry flows.** To illustrate, consider Row 18, Machinery. Part of the output is sold

WASHINGTON INTERINDUSTRY GROSS FLOWS T

(Millions of Dollars, Producers' Prices)

For the distribution of output of an industry, read across the row for that industry.
For the composition of inputs to an industry, read down the column for that industry.
Transactions of less than $50 thousand indicated by an asterisk.

WASHINGTON INDUSTRY PRODUCING	WASHINGTON INDUSTRY PURCHASING																							
	Agriculture	Livestock and Products	Misc. Agric. and Fishing	Meat and Dairy	Canning, Preserving and Milling	Other Food and Beverages	Textiles and Apparel	Mining and Forestry	Logging and Sawmills	Plywood, Millwork and Furniture	Pulp and Paper Mills	Printing and Publishing	Petroleum and Chemicals	Stone, Clay, and Glass Products	Iron and Steel Mills	Nonferrous Metal Mills	Fabricated Metal Products	Machinery	Aerospace	Ship and Boat Building	Other Manufacturing	Transportation and Warehousing	Utilities and Communications	Construction
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Agriculture	9.1	6.9	—	—	80.6	23.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*	—
2. Livestock and Products	—	16.3	—	173.8	0.1	2.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3. Misc. Agric. and Fishing	1.0	—	0.3	—	20.0	—	0.5	—	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	*	**1.3**
4. Meat and Dairy Products	—	0.7	0.3	34.1	3.0	1.2	—	—	—	—	—	—	0.7	*	—	—	—	—	—	—	*	0.6	—	—
5. Canning, Preserving and Milling	—	31.0	0.3	4.5	7.5	13.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.1	—	—
6. Other Food and Beverages	—	1.9	0.3	2.0	6.0	16.3	—	—	—	—	*	—	*	—	—	—	—	—	—	—	—	0.2	*	—
7. Textiles and Apparel	0.1	—	0.7	*	1.9	—	3.5	—	0.2	0.2	0.3	—	*	—	—	0.1	—	—	0.1	0.1	0.4	0.2	*	**1.0**
8. Mining and Forestry	—	—	—	—	—	0.5	—	3.1	84.0	5.0	0.8	—	0.9	20.5	0.3	1.0	—	—	—	—	—	0.7	—	**14.6**
9. Logging and Sawmills	—	—	—	—	—	—	—	0.1	124.5	66.3	62.2	—	*	0.1	*	—	*	*	0.1	0.3	0.3	—	*	**40.6**
10. Plywood, Millwork and Furniture	1.1	—	0.2	0.1	0.1	0.7	—	—	—	18.5	3.4	—	0.2	—	0.1	0.4	*	0.1	0.5	0.8	0.4	2.8	*	**26.8**
11. Pulp and Paper Mills	7.1	0.1	0.5	4.9	10.6	13.0	0.4	0.1	*	1.1	61.9	10.3	1.6	4.5	—	0.1	0.7	0.5	0.7	0.3	0.5	0.6	0.6	*
12. Printing and Publishing	0.1	0.1	*	*	0.1	4.2	*	*	0.6	0.3	0.2	2.7	0.4	0.5	—	0.1	—	0.1	2.6	0.2	*	0.7	1.7	**0.8**
13. Petroleum and Chemicals	14.9	3.0	1.1	1.0	0.6	1.9	0.1	1.2	2.2	9.5	17.9	2.0	12.2	4.5	0.2	1.4	1.7	0.1	1.7	1.0	0.4	24.6	4.3	**13.4**
14. Stone, Clay and Glass Products	0.4	—	0.1	0.7	1.5	6.6	—	1.2	0.3	0.6	1.7	—	0.3	16.8	1.6	0.5	0.2	0.2	0.4	0.5	0.1	0.2	0.1	**73.6**
15. Iron and Steel Mills	—	—	—	—	—	—	—	—	0.1	0.2	0.3	—	0.2	0.6	1.2	0.6	12.7	3.7	0.2	4.0	5.0	0.6	0.1	**13.3**
16. Nonferrous Metal Mills	1.9	—	—	—	—	—	—	—	0.1	0.5	0.1	—	1.8	0.1	0.2	16.3	0.8	2.0	2.3	0.5	2.2	—	0.2	**2.8**
17. Fabricated Metal Products	—	—	*	1.3	15.2	10.3	0.1	0.2	0.8	0.4	0.8	0.2	1.8	0.8	0.1	0.1	3.8	1.1	1.0	1.5	2.0	0.8	1.0	**41.8**
18. Machinery	*	—	0.1	*	0.5	0.2	—	0.7	1.8	0.7	1.7	—	1.3	1.2	0.1	0.2	0.7	5.1	10.9	2.5	0.1	0.4	0.8	**4.5**
19. Aerospace	—	—	—	—	—	—	—	—	—	—	—	—	0.1	—	—	—	*	*	15.0	—	—	0.8	—	*
20. Ship and Boat Building	—	—	0.4	—	—	—	—	—	—	—	—	—	0.1	—	—	—	—	—	—	0.3	—	0.6	—	—
21. Other Manufacturing	0.6	0.3	0.1	*	—	—	—	—	0.1	0.2	0.4	0.1	0.7	0.2	—	*	—	0.1	2.0	0.5	2.6	0.6	0.1	**0.6**
22. Transportation and Warehousing	1.8	1.7	0.4	10.5	11.0	10.8	0.1	1.0	39.4	10.2	14.9	0.8	10.0	6.8	1.1	4.6	0.8	0.5	1.3	1.0	0.5	2.3	3.9	**15.4**
23. Utilities and Communications	7.4	2.3	1.1	4.2	5.5	5.7	0.4	0.9	5.4	3.5	21.1	1.8	13.4	2.5	2.2	21.2	2.2	1.9	9.9	1.3	1.0	8.3	52.9	**4.9**
24. Construction	6.8	3.6	0.4	1.3	1.3	1.2	0.1	0.1	0.3	0.3	1.5	0.4	1.1	*	0.4	0.1	*	0.3	2.1	0.1	0.3	12.6	12.6	**1.1**
25. Wholesale and Retail Trade	5.5	5.0	1.0	10.2	10.7	9.7	0.4	1.5	20.7	10.4	15.8	1.2	3.0	3.2	4.2	2.7	1.7	3.0	2.7	2.6	0.7	8.5	3.4	**42.7**
26. Finance, Insurance, Real Estate	5.0	2.2	0.9	2.3	5.2	3.4	0.8	2.4	4.1	3.3	8.8	1.5	3.9	2.0	1.0	3.9	2.0	2.0	3.6	1.8	1.5	6.2	6.3	**10.1**
27. Business and Personal Services	9.6	1.6	1.6	6.3	6.5	6.4	0.8	1.2	7.0	5.4	5.3	5.6	6.0	1.4	1.0	3.1	1.7	2.0	6.0	3.5	2.4	16.3	9.9	**27.3**
Subtotal: Washington Purchases	72.4	76.7	9.8	257.2	187.9	131.3	7.2	13.7	291.6	136.6	219.1	26.6	59.8	65.7	13.7	56.4	29.0	22.7	63.1	22.8	20.4	89.7	98.1	**336.6**
Imports from rest of U.S.	69.0	79.8	5.7	58.6	89.1	30.0	33.3	17.4	15.8	36.9	117.8	6.0	90.7	10.6	9.6	194.9	52.7	61.7	517.7	47.9	57.4	47.4	72.4	**272.0**
Imports—Foreign	5.8	—	0.4	1.3	1.2	4.9	0.2	—	7.2	52.9	15.6	16.5	141.5	1.2	0.5	17.4	4.9	0.6	—	0.3	3.3	—	—	—
Value Created	249.1	78.9	32.5	82.7	111.0	157.8	31.8	118.8	269.4	145.3	336.6	73.7	282.8	53.7	44.5	149.3	68.0	121.4	629.3	147.0	55.8	390.4	461.4	**424.9**
TOTAL GROSS OUTLAY	396.3	235.4	48.4	399.8	389.2	324.0	72.5	149.9	584.0	371.7	689.1	122.8	574.8	131.2	68.3	418.0	154.6	206.4	1210.1	218.0	136.9	527.5	631.9	**1033.5**

Note: The Bremerton Navy Yard is included in Washington Industry 20, the Hanford Works in 13, and government utilities in 23.

University of Washington
College of Business Administration
Interindustry Study

2

INDUSTRY GROSS FLOWS TABLE, 1963

lions of Dollars, Producers' Prices)

tion of output of an industry, read across the row for that industry.
tion of inputs to an industry, read down the column for that industry.
actions of less than $50 thousand indicated by an asterisk.

HASING | FINAL DEMAND

	Nonferrous Metal Mills 16	Fabricated Metal Products 17	Machinery 18	Aerospace 19	Ship and Boat Building 20	Other Manufacturing 21	Transportation and Warehousing 22	Utilities and Communications 23	Construction 24	Wholesale and Retail Trade 25	Finance, Insurance, Real Estate 26	Business and Personal Services 27	Subtotal Washington Sales	Washington State and Local Government Expenditures	Washington Personal Consumption Expenditures	Wash. Private Capital Formation	Federal Expenditures	Exports to Rest of U.S.	Exports—Foreign	Final Demand Total	TOTAL GROSS OUTPUT	Wash Industry Number	Corresponding Standard Industrial Classification Code Number
	—	—	—	—	—	—	—	•	—	—	—	—	120.3	•	23.2	—	—	110.3	142.5	276.0	396.3	1.	01 – 07, 09
	—	—	—	—	—	—	—	—	—	—	—	0.2	192.4	—	38.5	—	—	4.5	—	43.0	235.4	2.	
	—	—	—	—	—	—	—	•	1.3	—	—	0.1	23.3	0.1	4.7	—	•	18.1	2.2	25.1	48.4	3.	
	—	—	—	—	—	•	0.6	—	—	—	•	1.0	41.6	8.0	259.2	—	14.4	65.5	11.1	358.2	399.8	4.	201 – 202
	—	—	—	—	—	—	1.1	—	—	—	•	1.5	59.4	2.0	44.7	—	16.2	242.5	24.4	329.8	389.2	5.	203 – 204
	—	—	—	—	—	—	0.2	•	—	1.1	•	2.3	30.1	1.8	173.0	—	4.1	114.5	0.5	293.9	324.0	6.	205 – 209
	0.1	—	—	0.1	0.1	0.4	0.2	•	1.0	—	—	0.1	8.9	0.1	18.0	0.4	1.4	43.4	0.3	63.6	72.5	7.	22 – 23
	1.0	—	—	—	—	—	0.7	—	14.6	—	—	0.1	131.5	0.3	0.8	—	2.9	12.3	2.1	18.4	149.9	8.	08, 10–14
	—	•	•	0.1	0.3	0.3	—	•	40.6	—	—	0.1	294.6	0.3	1.3	—	0.3	257.2	30.3	289.4	584.0	9.	241, 2421
1	0.4	•	0.1	0.5	0.8	0.4	2.8	•	26.8	1.2	•	0.1	57.5	2.5	9.1	5.2	9.3	285.6	2.5	314.2	371.7	10.	2422–2429, 25
—	0.1	0.7	0.5	0.7	0.3	0.5	0.6	0.8	•	13.5	0.3	0.5	134.6	2.1	11.0	—	5.7	496.1	39.6	554.5	689.1	11.	26
—	0.1	—	0.1	2.6	0.2	•	0.7	1.7	0.8	41.2	15.3	10.8	82.7	1.2	30.5	—	•	8.4	—	40.1	122.8	12.	27
12	1.4	1.7	0.1	1.7	1.0	0.4	24.6	4.3	13.4	13.2	2.6	5.3	142.0	6.7	110.9	—	220.9	92.2	2.1	432.8	574.8	13.	28, 29
6,	0.5	0.2	0.2	0.4	0.5	0.1	0.2	0.1	73.6	0.2	•	—	107.8	1.4	8.8	—	2.1	11.0	0.1	23.4	131.2	14	32
2	0.6	12.7	3.7	0.2	4.0	5.0	0.6	0.1	13.3	—	—	—	42.8	0.2	•	2.3	2.6	20.2	0.2	25.5	68.3	15.	331, 332, 3391, 3399
2	16.3	0.8	2.0	2.3	0.5	2.2	—	0.2	2.8	—	—	—	31.8	•	0.2	2.1	0.7	332.0	51.2	386.2	418.0	16.	All other 33
.1	0.1	3.8	1.1	1.0	1.5	2.0	0.8	1.0	41.8	0.8	—	2.8	88.7	1.1	2.8	5.3	7.2	47.5	2.0	65.9	154.6	17.	34
.1	0.2	0.7	5.1	10.9	2.5	0.1	0.4	0.8	4.5	0.5	—	0.6	34.6	1.1	5.2	30.0	25.3	101.6	8.6	171.8	206.4	18.	35, 36
—	—	•	•	15.0	—	—	0.8	—	•	—	—	—	15.9	0.4	—	—	775.4	319.2	99.2	1194.2	1210.1	19.	372
—	—	—	—	—	0.3	—	0.6	—	—	—	—	—	1.4	0.7	8.3	0.7	186.7	20.2	•	216.6	218.0	20.	373
—	•	—	0.1	2.0	0.5	2.6	0.6	0.1	0.6	1.4	0.1	0.3	11.0	1.0	4.8	4.2	2.8	105.4	7.7	125.9	136.9	21.	All other mfg.
1.1	4.6	0.8	0.5	1.3	1.0	0.5	2.3	3.9	15.4	19.8	5.0	5.8	181.4	4.6	105.7	5.4	15.2	172.0	43.2	346.1	527.5	22.	40 – 47
2.2	21.2	2.2	1.9	9.9	1.3	1.0	8.3	52.9	4.9	74.5	17.7	33.3	306.5	24.0	250.9	—	15.9	34.6	—	325.4	631.9	23.	48, 49
0.4	0.1	•	0.3	2.1	0.1	0.3	12.6	12.6	1.1	14.3	11.5	14.7	88.5	258.0	65.0	592.2	28.2	1.6	—	945.0	1033.5	24.	15 – 17, 656
4.2	2.7	1.7	3.0	2.7	2.6	0.7	8.5	3.4	42.7	25.2	6.7	33.3	235.7	13.6	1451.9	12.0	4.2	31.0	5.3	1518.0	1753.7	25.	50 – 59
1.0	3.9	2.0	2.0	3.6	1.8	1.5	6.2	6.3	10.1	53.6	42.9	35.3	216.0	15.3	361.0	3.5	24.3	36.9	—	441.0	657.0	26.	60 – 67, except 656
1.0	3.1	1.7	2.0	6.0	3.5	2.4	16.3	9.9	27.3	45.4	21.0	55.4	259.7	16.4	649.1	—	14.6	57.5	1.0	738.6	998.3	27.	70 – 89
13.7	56.4	29.0	22.7	63.1	22.8	20.4	89.7	98.1	336.6	305.9	123.1	203.6	2940.7	362.9	3638.6	663.3	1380.4	3041.3	476.1	9562.6	12503.3	Subtotal: Washington Purchases	
9.6	194.9	52.7	61.7	517.7	47.9	57.4	47.4	72.4	272.0	21.2	11.4	112.9	2139.9	246.8	1526.7	288.9	—	—	—	2062.4	4202.3	Imports from rest of U.S.	
0.5	17.4	4.9	0.6	—	0.3	3.3	—	—	—	8.3	—	0.3	284.3	•	81.1	•	—	—	—	81.1	365.4	Imports—Foreign	
4.5	149.3	68.0	121.4	629.3	147.0	55.8	390.4	461.4	424.9	1418.3	522.5	681.5	7138.4	590.3	853.6	—	483.7	—	—	1927.6	9066.0	Value Created	
8.3	418.0	154.6	206.4	1210.1	218.0	136.9	527.5	631.9	1033.5	1753.7	657.0	998.3	12501.3	1200.0	6100.0	952.2	1864.1	3041.3	476.1	13633.7	26137.0	TOTAL GROSS OUTLAY	

to the aerospace industry, $10.9 million, as shown in Row 18, Column 19. One of the items sold could be a small electronic motor installed as a component in an aircraft; here the output of the machinery industry is used as a current input by the aerospace industry. Suppose another firm in Washington's machinery industry sold a large electric motor to the aerospace industry which is used as a part of the heating equipment in an aerospace plant. This would not be considered an input for current production and would not be part of the $10.9 million of sales shown in Row 18, Column 19. Instead it would be entered as an investment, part of the $30.0 million entry of Row 18 and the Washington Private Capital Formation column. The rule, then is that only current inputs appear in the industry-to-industry portions of the table.

Analysis of Purchases: The Input Side

The above discussion indicates how the rows are to be interpreted so that the destination of outputs is known. Yet, input-output analysis is also interested, as the name implies, in the source of inputs used in the production process. Since one industry's purchase is another industry's sale, part of the source of inputs is known. For instance, the machinery industry's sales of $10.9 million to the aerospace industry means that aerospace bought $10.9 million worth of inputs from machinery. Thus, reading down any of the first 27 columns will show the amount of inputs pruchased from the industry named at the left.

For example, read down the first column, agriculture. As one of the entries, $14.9 million of inputs were purchased from the Petroleum and Chemical industry, Row 13 in Washington. The subtotal after Row 27 shows the total inputs purchased within the state. In the case of agriculture, $72.4 million of inputs were purchased within the state. Those inputs not purchased in Washington came from other states and from foreign nations. These amounts are shown for each industry in the next two rows. Finally, an entry called "Value Created" or, in other tables, "Value Added" appears. Value Created consists of the difference between a firm's output and what it purchases from other firms. It includes wages and salaries, rents, interest, depreciation, taxes, and profit (or loss). Because profit or loss is merely the difference between output and all input and non-input expenses, the total gross outlay of each industry equals the total gross output; i.e., inputs equal outputs.

The "Value Created" row is of special interest. As noted before, its sum, shown in the last column as $9,066.0 million, is equal to the Washington State Gross Product. This, in turn, is the regional equivalent of the United States Gross National Product, a widely used national economic statistic. The entry for each industry shows its contribution to Washington Gross Product. For PS&AW industries, these amounts were shown in Table III-2.

In summary, all Table IV-1 has done is to examine each industry from two viewpints: marketing and purchasing. From a marketing veiwpoint, reading across the rows shows where sales were made. From a purchasing viewpoint, reading down the column shows the source of current inputs. This is the essence of an input-output Gross Flows table. Further, once this table has been developed, all of the other tables associated with input-output discussed below emerge from this table.

Input Needs in Cents' Worth

Given familiarity with the Gross Flows table, the next step in the development of an input-output framework is to consider input purchases in a slightly different manner. All of the input purchases down a column are reduced to what could be called "a cent's worth." Suppose that each industry named at the top produces only one dollar's worth of output. Next follows the question, "In order to do this, how many cents' worth of inputs is needed from each of the industries named at the left?" For example, under Column one, Row 13, the entry $14.9 million shows the inputs purchased by agriculture from petroleum and chemicals. This purchase, however, was when agriculture's output amounted to $396.3 million. Suppose agriculture's output were only $1.00, how many cents' worth of petroleum and chemicals would be needed now? The answer is 14.9 divided by 396.3, or 3.8 cents' worth. It also can be thought of as what percentage of total inputs is purchased from an industry. This means that for every dollar of output of agriculture in Washington, 3.8 cents' worth of Washington petroleum and chemicals is needed. If this calculation is carried on for each and every input for each and every industry, a table of cents's-worth coefficients emerges. In input-output terms, this is known as a table of direct coefficients. This table is the same type as Table III-5 above for the PS&AW area, showing the source of inputs of some industries.

Impact Analysis

The next standard table of input-output analysis traces out the impact of each industry on all of the others. Referring back to agriculture, it was seen that to produce a dollar's worth of agriculture took among other inputs, 3.8 cents of petroleum and chemicals. Yet a look down the petroleum and chemicals column shows that they need inputs to produce their outputs, even it it is only 3.8 cents' worth. Thus, in order to produce agriculture's outputs, petroleum and chemical inputs are needed, and in turn the production of these will require still other inputs. And so it goes. In other words, to trace out the impact of a dollar's worth of agriculture's output requires tracing back the suppliers, the suppliers' suppliers, the suppliers' suppliers' suppliers and so on until the amounts are trivial. Were it not for the modern computers, all this would be difficult. The results of the computers' tracing-out effort produce a table showing the direct and indirect effects of different levels of output in each industry on all other industries. This table for the PS&AW area in 1963 is shown in the Technical Appendix to this report.

Ties to Ultimate Markets (Final Demands)

The final standard table of input-output analysis is the same as Table III-4 of the previous section. It answers the question, "How much of each industry's output is tied directly and indirectly to each of the ultimate markets?" It should be recognized that one industry's sale to another represents an intermediate flow of goods. Eventually these items are incorporated in goods or services sold to one or more of the final-demand sectors. Put another way, if there were no demand in any of these final-demand markets, there would be no sales from one industry to another. In this sense, the final-demand sector can be considered as ultimate markets toward which all outputs flow.

Consider again the agricultural industry row of Table IV-1. Reading across the first row, one sees that \$80.6 million was sold to the canning, preserving, and milling industry. Reading across Row 5, we find that the canning, preserving, and milling industry sold \$242.5 million of output to other regions of the United States. In this sense, part of agriculture's output is tied through interindustry relations to this and indirect ties were shown in Table III-4, above.

DEVELOPMENT OF THE PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE

The first major research effort of the PS&AW economic study was to develop the area's Gross Flows table for the year 1963. Given the previous discussion it is no surprise that the State of Washington table provided the basic data source. The steps involved in developing the PS&AW table from the State table are twofold: (1) the area's share of state output for each industry had to be derived; and (2) the flows: between industries, to regional markets such as consumers and investors, and to exports had to be estimated. (Fortunately, in both steps we were able to work with a more disaggregated State table than is shown in Table IV-1.) A brief explanation of these two steps follow.

PS&AW Total Outputs

The first step in developing the PS&AW Gross Flows table was to develop the output figures for each industry in the area (shown in the last column of Table III-3). Given that the output figures for the state were available, the problem was reduced to finding the area's share of each industry's output. (For the benefit of those tempted to suggest a more direct approach, such as to look up the PS&AW output data directly, we can report one small problem: none exist.)

Fortunately, wage and salary as well as employment by industry data for the PS&AW area were available. In view of their availability, the percentage employment in the area was used to estimate the share of total output. For industries in agricultural and forest products area, direct estimates were available from special studies cited later. In addition, for other industries such as aerospace, almost all of the state's production occurs within the PS&AW area. Thus, there is reasonable confidence in the output data.

Industry Flows

Even if total output is known, it is still necessary to estimate where the goods and services flow. Put another way, total output had to be distributed to (a) industries within the area; (b) local consumers, local investors, and local governments;

and (c) to markets outside the area. Here again, a modification of the State of Washington table was the approach used.

Recall that the state data also developed a table of direct coefficients—the table showing the cents' worth of inputs needed per dollar of output. These were modified to account for the relative supply and demand in the area by a technique appropriately delegated to the Technical Appendix. Local consumer, investor, and state and local government purchases were estimated directly (as were sales to the Federal government). Sales to foreign nations were estimated on a share of the state total. After all of these sales estimates, the remainder were allocated to sales to other areas of the nation.

Again we remind the reader that some two-thirds of the state's economic activity takes place within the PS&AW area. In addition, other information was available to modify the adjustment formulas.

THE OVERALL AREA PROJECTION METHOD TO 1980

The table for the PS&AW described above provided the basic data to be projected to 1980 and on to 2000 and 2020. The major projection effort was focused on the year 1980. This was done not only because it is a more proximate target, but, in addition, the trends established could be extended out to 2000 and 2020. Thus, the major discussion concerns how the projections to 1980 were developed.

Simply stated, the projection to 1980 took two forms: (1) for some industries, direct output projections to 1980 were taken from a variety of sources; and (2) for the vast majority of industries, projections for the demand for their outputs were developed. For this latter group, what has come to be known as an "export base" model or framework was utilized.

Direct Output Projection

For 16 of the 56 industries, total output and value added were projected independently. These industries are shown in Table IV-2 with their projected levels of output in 1980 contrasted with 1963 output. With the exception of a couple of cases, the reader can probably see why these 16 industries were projected on the basis of total output. In many cases the amount of output which can be reproduced is limited by supply of resources. In the first 13 industries: agricultural, fishing and forest products, this is clearly the case. Aluminum representa a special case because of its rapid growth in the PS&AW area. A study sponsored by the Bonneville Power Administration was the source of this projection. This leaves only aerospace and petroleum refining to consider.

TABLE IV-2. 1963 and projected 1980 output of Puget Sound and Adjacent Waters independently projected industries

(Note: 1980 projected outputs are in millions of 1963 dollars)

No.	1963	1980 Projected Industry
1 Field Crops, Including Seeds	3.2	2.1
2 Vegetables, Fruits, & Nut Crops	19.3	32.1
3 Livestock & Livestock Products	97.7	124.8
4 Special and Misc. Products	15.4	23.7
5 Fishing	15.6	16.5
15 Forestry	26.6	26.3
16 Logging	96.2	96.2
17 Sawmills	125.3	70.5
18 Veneer and Plywood	126.5	125.3
19 Misc. Wood Products	65.7	79.3
21 Pulpmills	59.4	69.2
22 Paper Mills	166.6	352.9
23 Misc. Paper & Paperboard Mills	123.2	261.0
27 Petroleum Refining & Related Industries	255.9	511.8
32 Aluminum	8.5	310.3
39 Aerospace	1,206.5	4,396.4

Note: These projections were developed from a variety of sources. See the Technical Appendix for details.

a. Aerospace—Clearly, the aerospace projection largely reflects expected activities at The Boeing Company, although it should not be forgotten that there are many other firms in the industry. In fact, the projection used here allows for some three to six percent of the output to be non-Boeing. It is patently impossible for a firm such as Boeing to know what its output will be 13 years hence and who its customers will be. Yet it is possible to consider the potentialities which management must take into account. With the fine cooperation of Boeing officials, a range of possible outcomes was projected. These ranges are governed by the decisions management faces with respect to its operations in the PS&AW area. At one end, management could fill its present and already planned plant in the area and leave it at that. This will

generate a low-side estimate of sales, value added, and employment. At the high end, it could expand by using up existing and potential industrial sites at its disposal in the area thus generating a higher projection. This study at first, split the difference between the low and the high range. The announcement of the Supersonic Transport award, however, suggested the future should be moved up slightly.

It must be cautioned that the estimates are not projections by Boeing officials. The possible levels of output in this area will depend upon a number of factors including the availability of necessary labor, community facilities, and other variables which affect the cost of operations.

b. Petroleum—The projections of the petroleum industry's output were developed in a Bonneville Power study cited below. The possibilities for added refinery capacity are excellent as Table IV-2 shows. One factor which could affect this future is the discovery of oil off the Washington or Oregon coast. This study assumes no major discoveries will occur. If they should, these estimates will need to be adjusted.

For the 16 industries whose outputs were projected to 1980 independently, the levels of exports to other areas, to the Federal Government, and to world trade were determined by subtracting out local demands. For all of the other industries, estimates of their export demands were generated by the study. Because the role of exports in an area's growth is so crucial, a few words on the export base framework are in order.

The Export Base Framework

The fact that an area grows or declines depending upon its ability to export to other areas is rather general knowledge. The loss of coal exports from Appalachia provides one of the reasons for its present state of distress. The current economic growth in the Puget Sound Area, in part, rests upon the expanded export activities of the aerospace industry. In this context, it should be repeated that the term "export" refers simply to sales outside of the area and not to foreign trade alone. For some areas, such as the PS&AW area, sales to the Federal Government constitute an important component of the export market. This was seen in Figure III-2 above. In general, then, some industries have their level of output determined by Federal, national, and international demands. Other industries, such as retail, serve the local market. Their levels of output are determined by the general economic vitality within the area. Thus the export base framework divides industries into two groups: those that serve outside markets and those that serve internal markets. As an area expands its sales to outside markets, output levels in internal markets will also increase.

Export Projections

The determination of the export sales of the various industries of the PS&AW area in 1980 depends upon demands generated outside of the area. The study identified four separate areas of demand: (1) Federal Government demands, especially those for defense-space activities; (2) world trade demands; (3) demands originating in the states of California and Oregon; and (4) demands emanating from the rest of the United States, omitting those two states. Since the volume of sales going to each of these markets for 1963 was known, the task is to project these markets to 1980.

a Federal Sales Projections—Projections of sales to the Federal sector in 1980 were taken from the recent work of Clopper Almon, cited below. For the year 1980, Almon has developed a set of estimates of "defense-life" purchases by the Federal Government. These were made under varying circumstances; the ones used for this study were made under the assumptions that the cold war will continue. The basic premise in the projection was that the PS&AW area would supply the same share of these defense-life expenditures in 1980 that it held in 1963. One important exception in this projection process concerns the aerospace industry. For this industry, as discussed before, total output was projected and the projection of sales to the Federal Government shown in Table V-3 below should be interpreted with caution. It should also be noted that the more routine activities of the Federal Government within the PS&AW area, such as the Post Office depend more on local growth than on national forces. Thus, they were included with state and local governmental expenditures and projected along with them.

b. World Trade Projections—Projections of world trade sales from PS&AW industries were again made on the basis of national trends in the various industries. World trade, here, applies to sales by Puget Sound industries to world trade. This is not the same thing as the volume of shipments through the various ports of the Puget Sound area, which includes many products not produced in the area.

For the United States, world trade projections were made for various commodity groups to various

blocks of countries for the years 1964 to 1970. These commodity groups were rearranged into the PS&AW input-output categories. The rates of growth of each of these categories were then estimated for the years 1964 through 1970, and the same rate was projected on out to 1980.

While the source for the United States projections was an unofficial working paper of the United States Department of Commerce, it is felt that these are the best estimates available. Again, for some industries—notably aerospace, aluminum, and the forest products industries—no separate projections of world trade were made. Rather, these industries' outputs were determined independently, as noted above.

c Exports to California-Oregon and the Rest of the United States—Exports out of the Puget Sound to the rest of the United States were divided into two categories: those going to California and Oregon, and those going to the rest of the United States, exclusive of California and Oregon. (Export sales to the rest of Washington are included with those to the rest of the United States. Although it would have been desirable to consider these as a separate category, it was impossible to project the level of outputs in this area separately from the rest of the United States.) This division recognizes the fact that these two markets are of differential importance to the PS&AW area. As was shown in Figure III-2, approximately 30 percent of the export sales to the United States market as a whole go to California and Oregon. This is greater than one would expect on the basis of those states' share of the United States' population, and simply reflects their geographic proximity to the PS&AW area. Since the California-Oregon region is projected to grow at a faster rate than the United States average, it is useful to separate the export market into these two components.

The 1963 export sales of the various industries in the PS&AW area to California and Oregon were determined through two procedures: (1) development of a table showing the sales of each PS&AW industry to other industries and ultimate markets in the United States, and (2) allocation of the share of these sales that goes to California and Oregon. The former task was accomplished by generating an export table, Table IV-3. This table shows for selected PS&AW industries names at the left, the buyers in other areas of the United States. For example, the canning and preserving industry sold 95 percent of its exports to the consumers in other areas of the nation in 1963. The data on these sales were derived in the original Washington input-output study from interviews with the firms themselves.

The share of the sales going to California and Oregon was determined from an unpublished Ph.D. thesis at the University of Washington by Dr. Roger Riefler. His study, which linked the California and Washington economies together, derived estimates based on various shipment data.

Output projections for the California and Oregon economies were made available to us through Dr. Curtis Harris, formerly with the Regional Economic Division, Office of Business Economics, United States Department of Commerce. Dr. Harris projected not only outputs of various industries in each of these states, but income levels as well. Given the trade ties to the two states in 1963, it was possible to project

TABLE IV-3. Distribution of non-federal exports to other regions of the United States by purchasing industry or market: illustrative industries, 1963

(For each Puget Sound and Adjacent Waters Industry at the left, the percentages exported to various industries and markets is shown at the top.)

		Purchaser Outside of Puget Sound and Adjacent Waters						
No.	Puget Sound and Adjacent Waters Industry	Non-Durable Goods Industry	Durable Goods Industry	Service Industry	Consumers	State and Local Governments	Investment	Total Exports
8	Canning and Preserving	2%	0%	1%	95%	2%	0%	100%
37	Non-Electrical Industrial Processing Equipment	14	8	1	0	1	76	100
43	Railroad, Water, Air, Motor, Transport, Pipelines, and Transportation Services	32	18	27	19	1	3	100

what the sales would be in 1980, given the new levels of output in the two states. (Additional details and some of the modifications used in projecting these sales are discussed in the Appendix to this report.)

The estimate of export sales to the rest of the United States (excluding California and Oregon) for 1980 was carried out in a manner similar to that used to determine the sales to California and Oregon. Given the sales in 1963 and given the projections to 1980, again using the Harris data, it was possible to determine how the new levels of output in various United States industries would affect the sales of Washington industries. (Again, a more detailed discussion and some of the additional refinements introduced are given in the Technical Appendix.) In the case of exports both to California and Oregon and to the rest of the United States, no attempt was made to forecast the sales of those industries independently projected. The above discussion sheds some light on how the four export markets were estimated for 1980 for 40 industries in the Puget Sound and Adjacent Waters area. Given these estimates, the next task was to determine the output levels for those industries described above as locally oriented.

d. Recreation and Tourism Expenditures Recreation and tourism, unfortunately, cannot be separated out as individual markets because of lack of data. In terms of the S.I.C. code there is no tourism and recreation industry as such. Rather it consists of a number of industries such as hotels and motels, sporting goods stores and other such industries, part or all of whose output is connected with recreation and tourism expenditures. In this study, part of these expenditures appear as consumption expenditures by local residents. Those recreation and tourism expenditures made by non-residents appear in the export column. While it is not possible to measure this impact, it is safe to note that as incomes per capita rise, these expenditures will become even more important as Figure IV-1, discussed shortly, shows for consumer spending on boats.

The Impact of Locally Oriented Industries

The impact of increased import sales on regional economy takes two forms: (1) an indirect or "linked" industry impact; and (2) an "induced" impact via consumer, investment, and state and local governmental spending. These two kinds of impacts can be considered separately.

a. The Indirect or "Linked" Impact The indirect or "linked" industries impact can be traced out by the generation of a table similar to Table III-5 shown above. Thus, for every dollar's increase in the export sales of, say, chemicals, the direct and indirect impact on all other industries in the PS&AW area can be determined. This was done by constructing a table for the year 1980 similar to Table III-5 for the year 1963.

In constructing this table, it was necessary to adjust for technological changes. Thus, in 1980 it would be expected, for example, that industries in the PS&AW area would use more computer services per dollar of output than was true in 1963. Based on changes in national technological relationships, these changes were introduced into the PS&AW table. A second type of change concerns what has come to be known as "import substitution." The assumption is that as a region grows larger in economic size, it will produce relatively more goods within its own boundaries and import less from outside. By comparing the PS&AW area to regions of a size about the same as the expected 1980 level, the table of direct ("cents' worth") coefficients was adjusted to allow for import substitution. Thus, for the year 1980, it was possible to determine not only the export sales of the various industries, but, in addition, the sales of other industries tied directly and indirectly to these same markets.

b. Induced Impact *The induced impact* comes via the spending of consumers, investors, and state and local governments. Added income generated in the industries tied directly and indirectly to the export markets will be spent by consumers on various goods and services. In addition, business firms will have to invest as their levels of output rise. Finally, state and local governments as well as locally oriented Federal activities will have to increase their volumes to satisfy increased demands. Thus, it is necessary to account for these changes to get a complete picture for the PS&AW area in 1980.

The most important impact of local induced spending comes through consumer purchases. These, of course, are the purchases that have an impact on the retailer, the barber shop, and the local dairy. In addition, just as with export sales, they also have an impact on suppliers to these particular outlets. Changes in the level and pattern of these expenditures between 1963 and 1980 take two forms. The data

IMPACT OF CONSUMER SPENDING ON PUGET SOUND AND ADJACENT WATERS INDUSTRY BY TYPE OF INCOME CHANGE

(THE LEFT HAND COLUMNS SHOW THE PURCHASES BY CONSUMERS OF PRODUCTS PRODUCED IN THE P.S. & A.W. WHEN GROSS REGIONAL PRODUCT GROWS BECAUSE OF ADDED JOBS BY $1 MILLION, BUT INCOMES PER CAPITA REMAINS THE SAME, THE RIGHT HAND COLUMNS SHOW THE IMPACT OF A $1 MILLION INCREASE IN GROSS REGIONAL PRODUCT ALL IN THE FORM OF INCREASE PER CAPITA INCOME TO THE RESIDENTS)

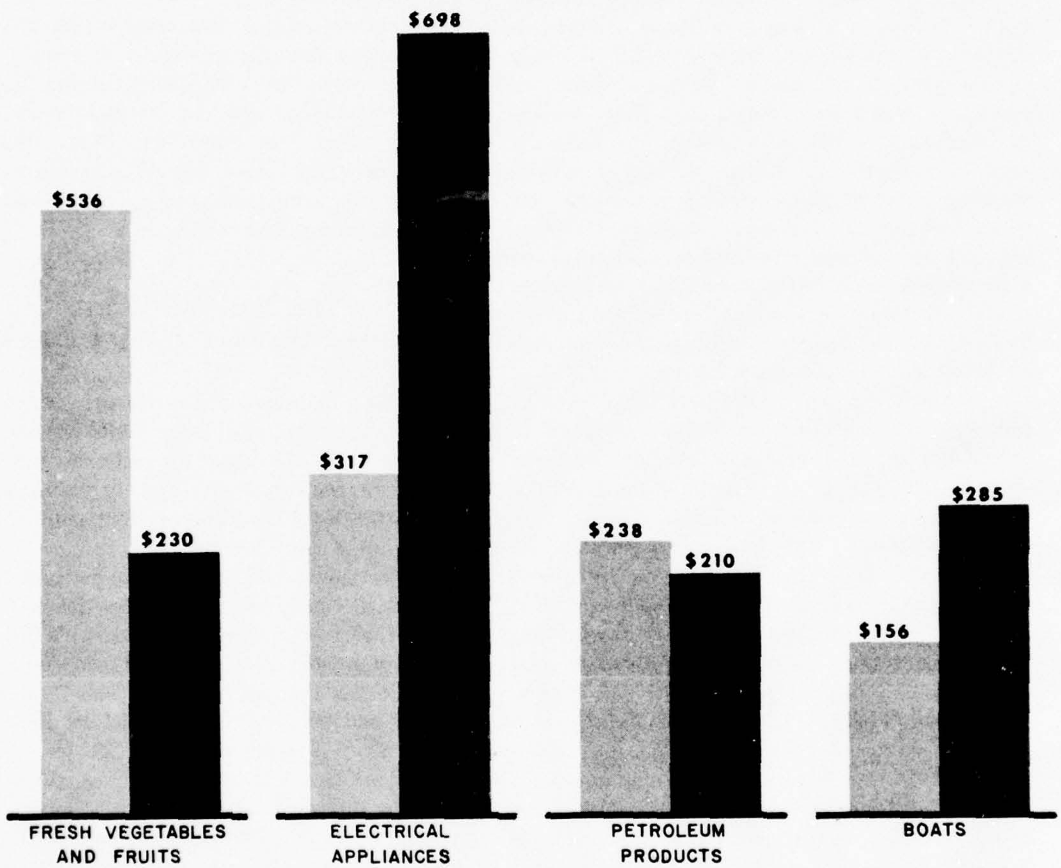


figure IV-1

suggest that as a region grows in income only because of employment opportunities, new residents will purchase the same pattern of goods as established residents.

Insofar as the total income in the PS&AW area rises because of increased per capita income, the pattern of spending by consumers takes on a new form. As per capita incomes increase, for example, relatively more is spent on luxury items and less on what are considered necessities.

In Figure IV-1, a typical dollar's spending (reflecting average tendencies in 1963) is shown on the left. As new residents move in to fill the newly created jobs in the area at the same wages and salaries, it would be expected that their spending patterns would reflect these averages. Thus, the left hand bars show the current pattern of today's spending. However, as incomes per person rise, new patterns of spending take place. These are shown on the right side in Figure IV-1. As can be seen the extra dollars of added per capita income are spent more on the luxury items such as electrical appliances and boats while relatively less is spent on fresh vegetables and fruits and petroleum products.

In order to account for these two types of consumer spending patterns, it was necessary to project not only the increase in total income in the PS&AW area, but to ascertain how much of this represented per capita income increases and how much represented simply more employment at the same income levels. This was done by introducing productivity factors based on national averages for each industry in the area. Thus, with estimates of regional change for both per capita income and total employment levels, the induced impact via consumer spending was derived.

Turning to other types of local spending, added income in the area will also have an impact on housing investment, plant and equipment investment, and, in addition, on the spendings of state and local governments as well as some Federal locally oriented activities. Data for the post war period for the PS&AW area indicate that spending on goods of these kinds follows the overall level of regional income. Thus, to project their levels of output in 1980, it was only necessary to determine the overall Gross Regional Product in the PS&AW Area.

Labor Force and Population

The above techniques provide forecasts of the output and value added in each industry group. Employment estimates were generated by taking output per employee in 1963 and, after adjusting for productivity increases in each industry, deriving employment from the sales forecasts. Naturally, as even students of the "old" mathematics appreciate, adding up the employment in all industries yields total employment.

Total employment, in turn, provides the basis for estimating population. How? Add an assumed four percent unemployment to the employed and this yields the labor force.

Next, from past data, estimate the labor force participation rate—the percentage of persons in the population who are in the labor force. Finally, divide the labor force participation rate into the labor force for the estimate of population. (Note—these estimates, of course, allow for net inmigration to fill needed jobs. In a sense then, jobs create the labor force and, in turn, the population.)

THE 2000 AND 2020 PROJECTIONS, OVERALL AREA

This discussion summarizes the general techniques used to project to 1980. Additional details are specified in the Technical Appendix. As mentioned earlier, the major task of the study was to generate 1980 estimates. Projections to 2000 and 2020 were carried out in a different manner.

For these years, few national projections were available and none were in industry detail. Thus, it was not feasible to attempt to construct a full-blown input-output table similar to that developed for 1980.

For some industries, particularly those in agriculture and forest products noted in Table IV-2, independent projections were made by the same studies mentioned earlier. For the other industries, the 17 year trend rates from 1963 to 1980 were extended on out to 2000 and 2020. As with the 1980 projections, due allowance was made for technological changes and productivity increases. This trending plus independent study estimates provided the output, value added and employment estimates. Employment estimates, in turn, were utilized to project population by the same techniques used in 1980. In these later years, however, a slightly lower labor force participation rate was used. This is consistent with the past experience in the area.

Even before the results are presented in the next chapter, now is the time to note the possible

errors, especially for the years 2000 and 2020. Of all sources of error, the largest comes in at the individual industry level. It has been argued that for the typical manufacturing firm, thirty percent of the products it will be producing a decade hence are now unknown. By 2020, or 53 years hence, all the effects of technological change are impossible to account for in detail. Thus, in perusing the projections, we do urge recognition of this type of problem.

THE DIVISION PROJECTIONS

The allocation of 1980 PS&AW output to the three divisions of the area constituted a separate step in the projection process. For the year 1963, employment in the various industries in the three divisions was known. In projecting to 1980, it was first assumed that each industry in each division would keep its same share of the total on to 1980. Thus, for example, the North division would be expected to capture most of the growth in the petroleum industry, while the Central division would feel the impact of increased output in the aerospace industry. As a second step, however, as new information was available, this was incorporated into the analysis and the shares allocated to the divisions changed.

The general method was to identify those industries in each division whose output was tied directly or indirectly to the various export markets. This is equivalent to identifying the divisional components of Table III-4. For 1980, projected direct and indirect exports were assigned to the three divisions. The remaining or locally oriented output was assigned in proportion to the growth in exports. For the agricultureal and forest products industries, the independent studies provided the divisional allocations. Naturally, the three division totals add up to the regional total.

The projections out to 2000 and 2020 for the divisions were made in a slightly different manner. In essence, each division's share of the industry's growth form 1963 to 1980 was projected on to 2000 and 2020. As before, where other information was available, it was incorporated into the projections.

Aside from the usual bundle of woes for the projector, the division projections introduce a few pitfalls of thier own. First of all, because of problems of disclosure, it is not possible to show projections in the same detail as the 1980 regional projections. A second pitfall should be noted: any major change in the location of large plants, especially in the North or West divisions, will affect the results. (One reason we choose the input-output framework is to allow for modification of the results of new information on plant locations as they become available.)

The final problem concerns the interpretation of Gross Regional Product. For the overall area, this is a good indicator of the area's income, as noted above. At the division level, it is far less satisfactory. Especially for the North and West divisions, the difference between regional product and regional income accruing to residents can be quite large. This is the reason why both in the Study Summary and in the next chapter, the calculation of Gross Regional Product per capita for divisions was not appropriate.

CHAPTER V

PROJECTIONS: 1980, 2000 AND 2020

By now, some idea of the projection process is known. While the reader of the Summary (Chapter I) already knows some of the results, in this chapter the results are spelled out more fully.

The first section of this chapter consists of the 1980 results both for the overall area and the three divisions. The next section reports, albeit in less detail, on the projections to 2000 and 2020. The last section suggests how the findings can be evaluated, utilized and modified for specific purposes.

PROJECTION: 1980

The projections for 1980 are first considered for the overall area where general economic indicators, changes in industrial structure, shifts in markets and the projections of the large water using industries are given. The next section presents North, Central and West division projections.

The Overall Area

The overall growth in the area's economy is summarized in Figure V-1 which compares the growth in key indicators. Associated with the growth in employment to over the one million mark is a projected population in 1980 of 2.7 million people. This compares with the State Census Board's medium estimate of 2.6 million and the high range estimate of just under 2.8 million. The larger figure in this report assumes that net immigration will occur to account for the difference.

Overall Gross Regional Product is projected as $11.4 billion in 1963 prices. When contrasted with 1963 Gross Regional Product of $5.8 billion, this represents almost a doubling.

Gross Regional Product per capita is projected to rise by some 34 percent between 1963 and 1980. This is consistent with past United States experience where the compound growth rate has averaged about 1.8 percent per year.

A quick comparison of 1963 and 1980 by industry groups in Table V-1 shows the sources of the changes in output and employment. While output more than doubled, employment only rose by about half. This is not a statistical error, for increased prod :tivity implies more output per worker. (Another reason for different rates of growth between output and employment is not really related to productivity changes. Within any industry group, a shift from products requiring a great deal of labor per

TABLE V-1. Total employment and output by industry 1963 and projected 1980:—Puget Sound and Adjacent Waters
(Employment in 000's; sales in millions of dollars)

No.	Industry	Employment 1963	Employment 1980	Output 1963	Output 1980
1	Agri., For., Fish., & Mining	23.7	18.2	196.7	261.1
2	Food & Kindred Products	15.9	19.5	698.5	1,240.9
3	Lumber & Wood Products	19.7	8.3	413.7	371.3
4	Paper & Allied Products	9.4	14.7	349.2	683.1
5	Chemicals	2.3	1.9	70.4	138.6
6	Petroleum Refining	1.2	1.3	255.9	511.8
7	Stone, Clay & Glass	3.8	5.0	92.4	172.5
8	Primary Metals	4.1	7.3	118.8	518.6
9	Other Non-Durable Mfgrs.	15.1	19.7	168.7	344.3
10	Other Durable Mfgrs.	86.2	175.7	1,815.9	5,460.7
11	Trans., Com., & P.V.	40.2	36.2	615.6	1,192.8
12	Whsle. & Retail Trade	140.0	202.6	1,250.3	2,269.4
13	Services	144.0	230.1	1,149.5	2,185.9
14	Construction	41.2	54.5	673.8	1,359.7
15	Government	115.8	178.1	-	-
	Total	662.6	973.1	7,869.4	16,710.7

Note: Figures may not add to totals due to rounding.

PROJECTED GROWTH IN SELECTED INDICATORS
PUGET SOUND & ADJACENT WATERS 1963—1980

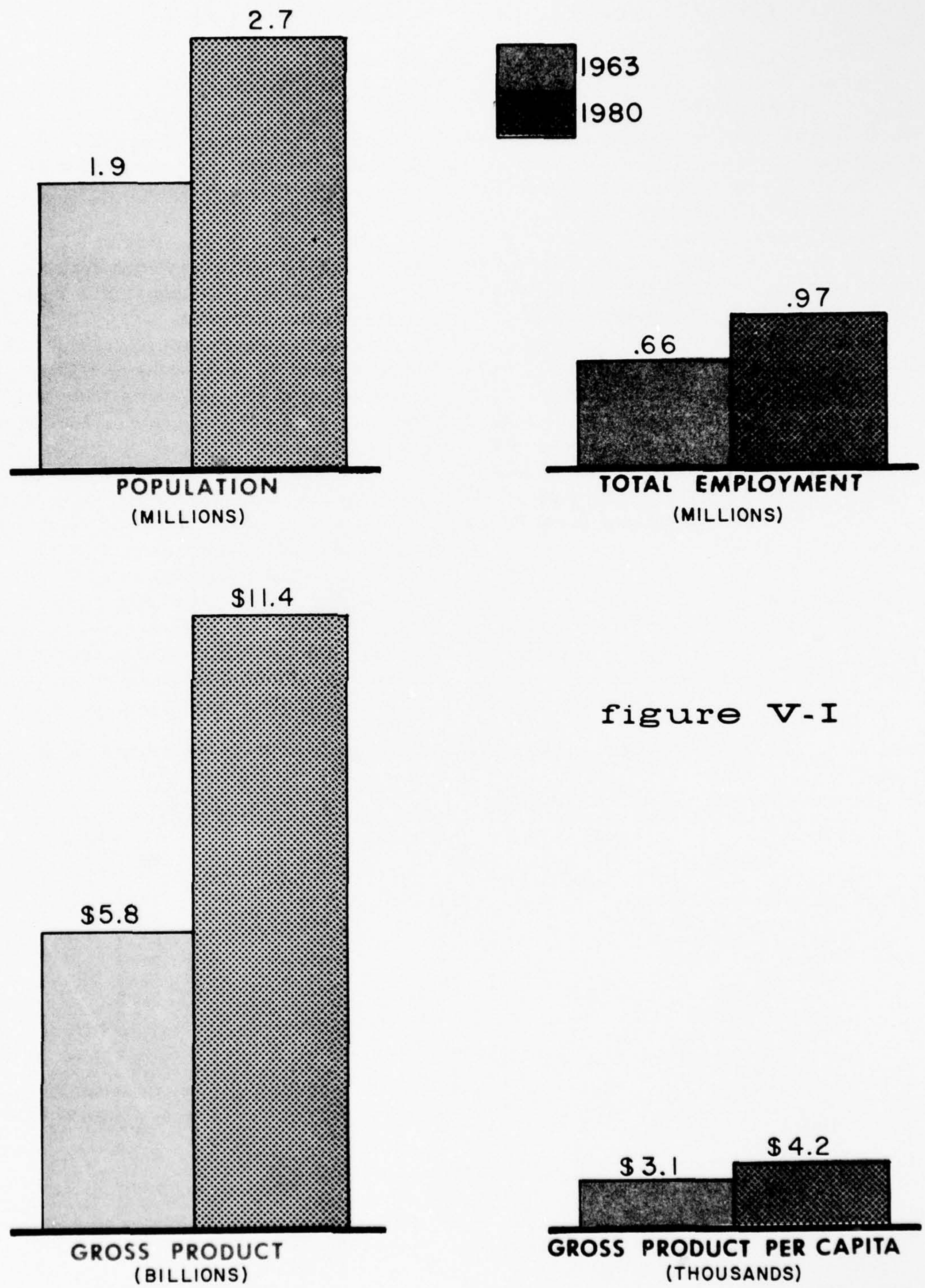


figure V-I

dollar of output to products requiring less labor will cause a divergence between output and employment growth.) For industries such as agriculture, lumber and wood products, chemicals, petroleum, and transportation services increased output is not enough to affect productivity gains, hence employment is projected to decline. Table V-2 gives the 1980 equivalent of Table III-3 for 1963. Recall that reading across the rows shows how the total output—far right on the last page—is distributed. Reading down the columns show the projected source of inputs. Row 58 under any column gives the value added or, the same thing, the industry's contribution to *Gross Regional Product*. The projected Gross Regional Product, the $11.4 billion mentioned earlier, appears as the sum of the values added in Row 58 and Column 63.

Since Table V-2 is difficult to inspect let alone digest, allow us to suggest some of the highlights.

TABLE V-2. Projected output flows by industry—Puget Sound and Adjacent Waters: 1980
(*In* 1963 producers prices, millions of dollars)
For each PS&AW industry named at the left, reading across the row shows the distribution of output to PS&AW industries and to final markets shown at the top.

TABLE V - 2
PROJECTED OUTPUT FLOWS BY INDUSTRY 1980

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		1 FIELD CROP	2 VEGETABLES	3 LVSTK$PROD	4 OTHER AGRI	5 FISHING	6 MEAT PRODS	7 DAIRY PROD	8 CANN$PRES	9 GRAIN MLLS	10 BEVERAGES
1	FIELD CROP	0.1	0.0	0.9	0.0	0.0	0.0	0.0	0.0	1.0	0.0
2	VEGETABLES	0.0	0.6	0.0	0.0	0.0	0.0	0.0	30.2	0.0	0.0
3	LVSTK$PROD	0.0	0.0	5.0	0.0	0.0	31.2	74.7	0.0	0.0	0.0
4	OTHER AGRI	0.0	0.6	0.0	1.0	0.0	0.0	0.0	1.9	0.0	0.0
5	FISHING	0.0	0.0	0.0	0.0	0.1	0.0	0.0	16.4	0.0	0.0
6	MEAT PRODS	0.0	0.0	0.0	0.0	0.1	7.7	0.0	0.8	2.3	0.0
7	DAIRY PROD	0.0	0.0	0.0	0.0	0.1	0.2	27.6	0.2	0.0	0.0
8	CANN$PRES	0.0	0.0	0.0	0.0	0.1	0.0	0.0	2.1	0.5	0.0
9	GRAIN MLLS	0.0	0.0	38.7	0.0	0.1	6.4	0.0	1.1	4.8	0.0
10	BEVERAGES	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	13.1
11	OTHR FOODS	0.0	0.0	0.0	0.0	0.2	0.7	1.7	5.0	1.3	2.2
12	TEXTILES	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0
13	APPAREL	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	2.0	0.0
14	MINING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	FORESTRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	LOGGING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	SAWMILLS	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	PLYWOOD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	OTHER WOOD	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.6
20	FURN$FIX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	PULPMILLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	PAPER MLLS	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.2	0.0
23	PAPBD MILS	0.0	0.0	0.0	0.0	0.0	1.9	2.8	6.3	2.6	8.9
24	PRINT$PUBS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	2.4
25	INDUS$CHEM	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
26	OTHER CHEM	0.0	0.3	0.6	0.2	0.0	0.0	0.0	0.2	0.2	0.4
27	PET REFINE	0.2	1.3	2.1	1.0	0.8	0.0	0.8	0.4	0.2	0.9
28	GLASSSTONE	0.0	0.0	0.0	0.2	0.0	0.0	0.8	1.5	0.0	9.1
29	CEM$CLAY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	IRON$STEEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	NONFER MET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	ALUMINUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	HEAVY METL	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.4
34	LITE METL	0.0	0.0	0.3	0.0	0.0	1.5	0.0	20.0	0.0	22.1
35	NONELC EQP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	MACH TOOL	0.1	1.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
37	NONELC EQP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2
38	ELEC MACH	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
39	AEROSPACE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	MOTOR VEH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	SHIP BLDG	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
42	OTHER MFGS	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
43	TRANSPORT	0.0	0.0	1.4	0.2	0.2	5.4	5.4	8.0	2.3	7.9
44	ELEC COMPY	0.0	0.0	1.5	0.3	0.0	0.3	0.5	0.8	0.5	0.6
45	GAS COMPY	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.8	0.5	0.4
46	WATER SERV	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.0	0.4
47	COMMUNICAT	0.0	0.0	0.5	0.2	0.1	0.8	0.5	0.6	0.2	2.4
48	P,U $ MISC	0.1	0.2	1.4	0.2	0.0	0.8	0.7	0.8	0.7	1.6
49	HOUSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	HIGHWAYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	WHSLE$RET	0.0	0.0	1.8	0.2	0.5	5.9	7.0	9.2	2.3	8.3
52	FINANCE	0.1	1.2	10.2	0.8	0.1	0.8	0.5	1.9	0.8	1.2
53	INSURANCE	0.1	0.7	1.1	0.5	0.2	0.8	0.8	2.1	1.0	1.8
54	REA ESTATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	BUSI SERV	0.0	0.0	0.0	0.5	0.6	2.5	3.2	3.1	2.3	3.6
56	PERS SERV	0.0	0.0	1.8	0.3	0.0	0.7	1.0	1.0	0.5	1.0
57	SUBTOTAL	0.7	6.1	68.6	7.5	4.3	68.5	129.5	115.6	26.4	89.5
58	VAL ADDED	1.3	25.0	43.2	16.2	10.9	38.7	50.0	80.8	20.3	114.0
59	IMPORTS	0.1	1.0	13.0	-0.0	1.3	125.8	14.5	33.1	96.0	26.9
60	TOTAL	2.1	32.1	124.8	23.7	16.5	233.0	194.0	229.5	142.7	230.4

TABLE V - 2
PROJECTED OUTPUT FLOWS BY INDUSTRY 1980

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		11 OTHR FOODS	12 TEXTILES	13 APPAREL	14 MINING	15 FORESTRY	16 LOGGING	17 SAWMILLS	18 PLYWOOD	19 OTHER WOOD	20 FURN$FIX
1	FIELD CROP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	LVSTK$PROD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	OTHER AGRI	0.0	0.0	0.6	0.0	0.0	0.0	0.8	0.0	0.0	0.0
5	FISHING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MEAT PRODS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	DAIRY PROD	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	CANN$PRES	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	GRAIN MLLS	19.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	BEVERAGES	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	OTHR FOODS	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	TEXTILES	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2
13	APPAREL	0.0	0.0	5.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0
14	MINING	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
15	FORESTRY	0.0	0.0	0.0	0.0	0.5	18.8	2.4	1.9	0.5	0.0
16	LOGGING	0.0	0.0	0.0	0.0	0.0	4.9	1[illegible]7	12.5	5.1	0.0
17	SAWMILLS	0.0	0.0	0.0	0.0	0.0	0.0	2.1	1.7	5.9	3.1
18	PLYWOOD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	2.2	1.6
19	OTHER WOOD	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.8
20	FURN$FIX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
21	PULPMILLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	PAPER MLLS	0.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	PAPBD MILS	6.7	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.1	1.0
24	PRINT$PUBS	3.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
25	INDUS$CHEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
26	OTHER CHEM	0.3	0.6	0.2	0.0	0.0	0.0	0.1	8.5	0.2	1.8
27	PET REFINE	1.4	0.0	0.0	1.5	0.0	0.6	0.5	0.0	0.8	0.2
28	GLASSSTONE	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
29	CEM$CLAY	0.0	0.0	0.0	0.9	0.0	0.0	0.1	0.1	0.1	0.0
30	IRON$STEEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
31	NONFER MET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	ALUMINUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
33	HEAVY METL	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0
34	LITE METL	0.2	0.0	0.2	0.1	0.0	0.1	0.1	0.0	0.3	0.1
35	NONELC EQP	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0
36	MACH TOOL	0.0	0.0	0.0	0.4	0.0	0.1	0.1	0.1	0.1	0.0
37	NONELC EQP	0.2	0.0	0.0	0.4	0.0	0.2	0.1	0.3	0.0	0.0
38	ELEC MACH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	AEROSPACE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	MOTOR VEH	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
41	SHIP BLDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
42	OTHER MFGS	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
43	TRANSPORT	7.2	0.0	0.2	0.8	0.0	6.9	4.7	3.8	1.8	2.2
44	ELEC COMPY	0.3	0.0	0.2	0.2	0.0	0.0	0.6	0.6	0.2	0.2
45	GAS COMPY	0.9	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.1	0.2
46	WATER SERV	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
47	COMMUNICAT	1.2	0.1	0.4	0.1	0.1	0.4	0.2	0.5	0.1	0.4
48	P,O $ MISC	0.3	0.0	0.2	0.1	0.0	0.1	0.0	0.1	0.1	0.0
49	HOUSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	HIGHWAYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	WHSLE$RET	7.4	0.0	0.8	1.1	0.0	3.3	3.4	3.7	2.9	2.6
52	FINANCE	1.0	0.1	0.4	0.2	0.2	0.2	0.2	0.4	0.1	0.2
53	INSURANCE	1.5	0.1	0.8	0.4	0.3	0.4	0.6	1.0	0.7	0.6
54	REA ESTATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	BUSI SERV	4.1	0.0	0.8	0.4	0.1	0.3	0.8	1.3	0.8	0.2
56	PERS SERV	0.9	0.0	0.4	0.2	0.0	0.4	0.3	0.7	0.5	0.4
57	SUBTOTAL	70.6	0.9	11.6	7.3	1.2	37.2	30.0	44.2	24.8	18.0
58	VAL ADDED	101.5	2.7	43.3	19.2	24.6	45.0	32.1	50.5	27.0	31.0
59	IMPORTS	39.2	3.5	41.2	9.1	0.5	14.0	8.4	30.6	27.5	13.0
60	TOTAL	211.3	7.1	96.1	35.6	26.3	96.2	70.5	125.3	79.3	62.0

TABLE V - 2
PROJECTED OUTPUT FLOWS BY INDUSTRY 1980

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		21 PULPMILLS	22 PAPER MLLS	23 PAPBD MILS	24 PRINT$PUBS	25 INDUS$CHEM	26 OTHER CHEM	27 PET REFINE	28 GLASS$STONE	29 CEM$CLAY	30 IRON$STEEL
1	FIELD CROP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	LVSTK$PROD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	OTHER AGRI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	FISHING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MEAT PRODS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	DAIRY PROD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	CANN$PRES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	GRAIN MLLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	BEVERAGES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	OTHR FOODS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	TEXTILES	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	APPAREL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	MINING	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.4	13.9	0.2
15	FORESTRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	LOGGING	12.0	15.4	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	SAWMILLS	2.2	4.5	1.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0
18	PLYWOOD	0.4	2.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	OTHER WOOD	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.2
20	FURN$FIX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	PULPMILLS	1.0	11.2	35.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	PAPER MLLS	0.1	0.2	5.5	10.6	0.0	0.2	0.2	0.2	0.2	0.0
23	PAPBD MILS	0.0	4.4	13.3	0.2	0.0	1.1	0.2	2.1	3.0	0.0
24	PRINT$PUBS	0.0	0.2	0.2	4.2	0.0	0.4	0.2	0.6	0.2	0.0
25	INDUS$CHEM	0.6	0.4	0.2	0.0	0.0	0.8	0.4	0.0	0.0	0.0
26	OTHER CHEM	0.6	3.2	1.9	4.0	0.8	3.1	0.2	0.8	0.2	0.2
27	PET REFINE	1.3	5.8	4.0	0.0	0.5	0.8	4.6	0.0	7.4	0.1
28	GLASS$STONE	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7
29	CEM$CLAY	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.2	16.3	1.0
30	IRON$STEEL	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0	1.0	2.6
31	NONFER MET	0.1	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.2	0.4
32	ALUMINUM	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
33	HEAVY METL	0.1	0.2	0.0	0.0	0.1	0.0	0.2	0.0	0.6	0.0
34	LITE METL	0.2	0.4	0.3	0.5	0.1	0.2	2.4	0.0	0.9	0.2
35	NONELC EQP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
36	MACH TOOL	0.1	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.9	0.2
37	NONELC EQP	0.3	1.3	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0
38	ELEC MACH	0.1	0.1	0.0	0.0	0.1	0.0	0.6	0.0	0.4	0.5
39	AEROSPACE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	MOTOR VEH	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.4	0.0
41	SHIP BLDG	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
42	OTHER MFGS	0.1	0.1	0.2	0.2	0.1	0.4	0.1	0.0	0.0	0.0
43	TRANSPORT	2.3	7.2	5.3	1.2	0.6	0.8	11.8	0.6	8.5	2.1
44	ELEC COMPY	0.5	4.4	2.1	0.6	1.7	0.2	2.5	0.4	0.9	2.1
45	GAS COMPY	0.6	5.1	1.9	0.2	0.0	0.0	0.2	0.4	0.6	1.0
46	WATER SERV	0.2	0.2	0.1	0.0	0.0	0.0	0.2	0.0	0.1	0.0
47	COMMUNICAT	0.1	0.8	0.4	1.6	0.2	0.2	0.6	0.2	0.6	0.6
48	P,O $ MISC	0.3	0.8	0.4	0.6	0.0	0.0	2.0	0.0	0.0	0.8
49	HOUSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	HIGHWAYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	WHSLE$RET	2.7	8.7	6.8	2.0	0.4	1.1	0.6	0.6	4.3	8.7
52	FINANCE	0.3	2.3	1.7	1.0	0.2	0.6	1.4	0.2	1.3	0.8
53	INSURANCE	0.7	3.2	2.3	1.6	0.2	0.8	3.0	0.4	1.3	1.0
54	REA ESTATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
55	BUSI SERV	0.3	1.3	1.1	1.8	0.1	0.6	2.6	0.4	0.6	1.5
56	PERS SERV	0.3	1.7	1.1	6.4	0.2	0.8	6.0	0.4	0.7	0.6
57	SUBTOTAL	28.9	86.4	91.0	36.7	5.8	13.5	40.6	7.9	64.9	26.7
58	VAL ADDED	26.0	197.8	111.0	102.5	36.2	32.1	123.0	19.3	51.8	82.4
59	IMPORTS	14.3	68.7	59.0	31.6	3.8	47.2	348.2	5.1	23.5	17.7
60	TOTAL	69.2	352.9	261.0	170.8	45.8	92.8	511.8	32.3	140.2	126.8

TABLE V - 2
PROJECTED OUTPUT FLOWS BY INDUSTRY 1980
PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		31 NONFER MET	32 ALUMINUM	33 HEAVY METL	34 LITE METL	35 NONELC EQP	36 MACH TOOL	37 NONELC EQP	38 ELEC MACH	39 AEROSPACE	40 MOTOR VEH
1	FIELD CROP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	LVSTK$PROD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	OTHER AGRI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	FISHING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MEAT PRODS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	DAIRY PROD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	CANN$PRES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	GRAIN MLLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	BEVERAGES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	OTHR FOODS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	TEXTILES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
13	APPAREL	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	MINING	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	FORESTRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	LOGGING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	SAWMILLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2
18	PLYWOOD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.4
19	OTHER WOOD	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.0	0.4	0.0
20	FURN$FIX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2
21	PULPMILLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	PAPER MLLS	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.7	0.0
23	PAPBD MILS	0.0	0.1	0.0	0.8	0.0	0.0	0.2	0.4	1.5	0.2
24	PRINT$PUBS	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	10.4	0.0
25	INDUS$CHEM	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.4	0.0
26	OTHER CHEM	0.1	0.0	1.6	0.5	0.0	0.0	0.0	0.1	2.3	0.4
27	PET REFINE	1.2	0.7	0.5	0.2	0.2	0.0	0.0	0.0	3.8	0.2
28	GLASS$STONE	0.0	0.0	0.2	0.2	0.2	0.3	0.0	0.2	0.8	0.2
29	CEM$CLAY	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
30	IRON$STEEL	0.0	0.8	22.5	1.7	5.4	1.2	0.4	0.4	0.3	10.2
31	NONFER MET	19.9	0.4	0.0	0.9	0.6	0.5	0.0	1.1	1.2	0.6
32	ALUMINUM	0.0	3.8	1.1	0.2	0.3	0.2	0.1	1.0	7.3	2.2
33	HEAVY METL	0.0	0.0	1.8	0.6	0.5	0.0	0.0	0.0	0.4	2.2
34	LITE METL	0.1	0.1	0.2	6.1	1.5	0.3	0.5	0.1	3.8	2.4
35	NONELC EQP	0.0	0.0	0.0	0.0	0.6	0.7	0.0	0.0	0.0	0.0
36	MACH TOOL	0.0	0.0	0.4	0.4	2.7	1.4	0.2	0.2	26.5	0.0
37	NONELC EQP	0.0	0.2	0.0	0.0	1.0	0.6	0.8	0.0	0.4	0.0
38	ELEC MACH	0.0	0.0	0.5	0.0	0.5	0.3	0.5	0.5	14.5	0.4
39	AEROSPACE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.7	0.0
40	MOTOR VEH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
41	SHIP BLDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	OTHER MFGS	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	7.6	0.2
43	TRANSPORT	0.0	3.7	0.6	0.6	0.4	0.0	0.2	0.2	4.7	0.6
44	ELEC COMPY	0.7	14.6	1.0	0.8	0.4	0.5	0.4	0.4	8.0	0.2
45	GAS COMPY	1.2	0.6	0.0	0.4	0.0	0.0	0.2	0.2	2.5	0.0
46	WATER SERV	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.7	0.0
47	COMMUNICAT	0.2	0.4	0.4	0.4	0.2	0.3	0.2	0.4	22.6	0.4
48	P,O $ MISC	0.0	0.1	0.0	0.0	0.2	0.3	0.2	0.0	7.7	0.6
49	HOUSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	HIGHWAYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	WHSLE$RET	1.0	3.7	2.4	0.8	1.8	1.3	1.7	1.2	9.8	0.8
52	FINANCE	0.2	0.9	0.8	0.8	0.2	0.3	0.4	0.2	3.6	0.6
53	INSURANCE	0.5	3.7	1.2	1.1	0.8	0.5	1.0	0.6	9.5	1.2
54	REA ESTATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
55	BUSI SERV	0.3	1.1	1.0	0.8	0.2	0.3	1.0	0.6	18.2	2.4
56	PERS SERV	0.3	1.3	0.4	0.6	0.4	0.3	0.4	0.4	3.6	0.4
57	SUBTOTAL	26.5	37.3	36.8	17.9	18.2	9.7	9.1	8.6	230.8	28.2
58	VAL ADDED	17.7	116.7	69.5	38.6	52.3	41.3	55.2	54.5	1846.4	55.4
59	IMPORTS	37.3	156.3	26.7	59.0	25.9	13.5	31.3	24.3	2319.2	82.5
60	TOTAL	81.5	310.3	133.0	115.5	96.4	64.5	95.6	87.4	4396.4	166.1

TABLE V - 2
PROJECTED OUTPUT FLOWS BY INDUSTRY 1980
PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		41 SHIP BLDG	42 OTHER MFGS	43 TRANSPORT	44 ELEC COMPY	45 GAS COMPY	46 WATER SERV	47 COMMUNICAT	48 P,O $ MISC	49 HOUSING	50 HIGHWAYS
1	FIELD CROP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	LVSTK$PROD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	OTHER AGRI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	FISHING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MEAT PRODS	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	DAIRY PROD	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	CANN$PRES	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	GRAIN MLLS	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	BEVERAGES	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	OTHR FOODS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	TEXTILES	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	APPAREL	0.1	0.4	0.2	0.0	0.0	0.0	0.0	0.8	0.6	0.0
14	MINING	0.0	0.0	0.4	0.0	0.0	0.0	0.0	1.8	1.4	7.4
15	FORESTRY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	LOGGING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	SAWMILLS	0.2	0.2	0.0	0.0	0.0	0.0	0.0	10.2	25.2	0.4
18	PLYWOOD	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.8	0.2
19	OTHER WOOD	0.2	0.2	2.4	0.0	0.0	0.0	0.0	6.0	14.7	0.2
20	FURN$FIX	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.6	0.0
21	PULPMILLS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	PAPER MLLS	0.1	0.2	0.0	0.2	0.0	0.0	0.6	0.0	0.0	0.0
23	PAPBD MILS	0.2	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	PRINT$PUBS	0.2	0.0	0.8	0.7	0.2	0.0	0.9	0.6	0.4	0.0
25	INDUS$CHEM	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
26	OTHER CHEM	1.2	0.3	2.6	0.0	0.0	0.0	0.0	2.8	4.9	0.2
27	PET REFINE	0.1	0.0	48.6	1.4	0.0	0.0	1.1	8.0	6.1	4.7
28	GLASS$STONE	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.9	0.2
29	CEM$CLAY	0.5	0.0	0.2	0.0	0.0	0.0	0.2	48.1	31.9	7.6
30	IRON$STEEL	4.8	0.2	0.8	0.2	0.0	0.0	0.0	8.5	7.9	1.3
31	NONFER MET	0.5	0.0	0.1	0.2	0.0	0.0	0.0	1.1	0.6	0.2
32	ALUMINUM	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.0
33	HEAVY METL	0.6	0.0	0.0	0.0	0.0	0.1	0.2	26.5	12.4	2.6
34	LITE METL	1.4	1.5	1.3	0.5	0.4	0.0	0.0	4.3	3.7	0.0
35	NONELC EQP	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	MACH TOOL	0.6	0.2	3.7	0.0	0.0	0.0	0.0	2.0	1.4	0.4
37	NONELC EQP	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	ELEC MACH	1.6	0.3	0.3	0.2	0.0	0.0	0.9	1.5	0.7	0.0
39	AEROSPACE	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	MOTOR VEH	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	SHIP BLDG	0.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	OTHER MFGS	0.6	3.3	0.2	0.0	0.0	0.0	0.2	0.6	0.2	0.0
43	TRANSPORT	1.1	0.4	2.6	3.1	0.0	0.0	0.2	9.6	7.3	3.4
44	ELEC COMPY	0.5	0.6	2.0	32.2	0.0	0.2	1.6	0.4	1.0	0.0
45	GAS COMPY	0.1	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	WATER SERV	0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.0	0.0
47	COMMUNICAT	0.5	0.4	5.2	0.6	0.2	0.0	2.4	3.2	2.0	0.4
48	P,O $ MISC	0.1	0.0	15.0	5.6	0.8	0.6	6.3	0.8	0.6	0.2
49	HOUSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	HIGHWAYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	WHSLE$RET	2.9	0.6	10.8	2.4	0.0	0.0	1.6	37.2	25.4	3.6
52	FINANCE	0.5	0.4	1.9	0.6	0.2	0.2	0.8	3.2	2.0	0.4
53	INSURANCE	1.6	0.6	6.3	2.2	0.4	0.2	2.9	5.8	3.8	0.8
54	REA ESTATE	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
55	BUSI SERV	3.4	1.3	6.3	4.1	0.6	0.2	3.1	21.8	7.9	4.9
56	PERS SERV	0.6	0.4	11.9	1.0	0.2	0.2	1.2	2.6	1.4	0.4
57	SUBTOTAL	26.1	13.2	130.1	55.3	3.0	1.9	24.6	212.4	170.4	39.5
58	VAL ADDED	164.4	39.1	414.8	168.7	20.8	20.0	270.3	283.5	225.6	49.7
59	IMPORTS	53.3	18.0	15.7	25.1	25.5	4.7	12.3	148.4	198.3	31.9
60	TOTAL	243.8	70.3	560.6	249.1	49.3	26.6	307.2	644.3	594.3	121.1

TABLE V - 2
PROJECTED OUTPUT FLOWS BY INDUSTRY 1980
PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		51 WHSLE$RET	52 FINANCE	53 INSURANCE	54 REA ESTATE	55 BUSI SERV	56 PERS SERV	57 SUBTOTAL	58 CONSUMP	59 STAT$LOC	60 FED EXPEN
1	FIELD CROP	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.1	-0.0	-0.0
2	VEGETABLES	0.0	0.0	0.0	0.0	0.0	0.0	30.8	1.3	-0.0	-0.0
3	LVSTK$PROD	0.0	0.0	0.0	0.0	0.0	0.0	110.9	13.9	-0.0	-0.0
4	OTHER AGRI	0.0	0.0	0.0	0.0	0.0	0.0	4.9	13.3	-0.0	-0.0
5	FISHING	0.0	0.0	0.0	0.0	0.0	0.0	16.5	-0.0	-0.0	-0.0
6	MEAT PRODS	0.0	0.0	0.0	0.0	0.0	0.6	12.3	145.9	8.2	8.6
7	DAIRY PROD	0.0	0.0	0.0	0.0	0.0	0.6	30.4	123.8	8.8	4.0
8	CANN$PRES	0.0	0.0	0.0	0.0	0.0	0.9	5.4	23.5	15.3	-0.0
9	GRAIN MLLS	0.0	0.0	0.0	0.0	0.0	0.9	71.6	14.3	6.3	-0.0
10	BEVERAGES	0.0	0.0	0.0	0.0	0.0	0.0	14.5	67.0	-0.0	-0.0
11	OTHR FOODS	1.6	0.0	0.0	0.0	0.0	3.2	24.6	122.4	5.4	2.4
12	TEXTILES	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.9	-0.0	-0.0
13	APPAREL	0.0	0.0	0.0	0.0	0.2	0.0	10.0	29.8	0.2	-0.0
14	MINING	0.0	0.0	0.0	0.0	0.0	0.1	27.4	0.1	0.6	0.8
15	FORESTRY	0.0	0.0	0.0	0.0	0.0	0.0	24.1	0.3	-0.0	-0.0
16	LOGGING	0.0	0.0	0.0	0.0	0.0	0.0	67.2	-0.0	-0.0	-0.0
17	SAWMILLS	0.0	0.0	0.0	0.0	0.0	0.1	59.0	0.9	0.6	-0.0
18	PLYWOOD	0.0	0.0	0.0	0.0	0.0	0.2	22.8	1.4	5.2	1.8
19	OTHER WOOD	1.0	0.0	0.0	0.0	0.0	0.0	29.4	1.4	5.2	2.0
20	FURN$FIX	0.0	0.0	0.0	0.0	0.0	0.0	3.4	9.8	1.3	0.1
21	PULPMILLS	0.0	0.0	0.0	0.0	0.0	0.0	47.2	-0.0	-0.0	-0.0
22	PAPER MLLS	4.2	0.0	0.2	0.0	0.2	0.4	27.2	6.8	4.6	-0.0
23	PAPBD MILS	10.7	0.2	0.2	0.0	0.0	0.2	70.6	1.3	0.8	-0.0
24	PRINT$PUBS	52.1	7.4	6.0	7.8	4.7	9.1	113.8	41.3	1.9	-0.0
25	INDUS$CHEM	0.0	0.0	0.0	0.0	0.0	0.0	3.4	-0.0	1.5	-0.0
26	OTHER CHEM	0.0	0.0	0.0	0.2	0.0	1.4	47.2	7.3	1.5	-0.0
27	PET REFINE	24.0	0.8	0.0	4.2	0.6	8.2	151.8	164.0	15.7	8.1
28	GLASS$STONE	0.4	0.0	0.0	0.0	0.0	0.0	19.8	2.2	0.2	-0.0
29	CEM$CLAY	0.0	0.0	0.0	0.0	0.0	0.0	109.8	8.4	2.5	1.1
30	IRON$STEEL	0.0	0.0	0.0	0.0	0.0	0.0	71.2	-0.0	2.5	-0.0
31	NONFER MET	0.0	0.0	0.0	0.0	0.0	0.0	29.2	-0.0	0.8	-0.0
32	ALUMINUM	0.0	0.0	0.0	0.0	0.0	0.0	19.3	-0.0	-0.0	-0.0
33	HEAVY METL	0.7	0.0	0.0	0.0	0.4	0.4	51.5	1.6	2.5	1.0
34	LITE METL	0.5	0.0	0.0	0.0	0.0	3.5	82.4	2.1	5.4	-0.0
35	NONELC EQP	0.4	0.0	0.0	0.0	0.0	0.0	2.8	3.2	3.6	-0.0
36	MACH TOOL	0.0	0.0	0.0	0.0	0.0	0.7	44.6	-0.0	5.9	-0.0
37	NONELC EQP	0.5	0.0	0.0	0.0	0.0	0.0	7.8	-0.0	0.7	3.4
38	ELEC MACH	0.0	0.0	0.0	0.0	0.0	0.0	24.6	3.8	1.5	7.4
39	AEROSPACE	0.0	0.0	0.0	0.0	0.0	0.0	55.6	-0.0	0.8	849.0
40	MOTOR VEH	1.5	0.0	0.0	0.0	0.0	0.0	4.1	2.4	2.1	0.1
41	SHIP BLDG	0.0	0.0	0.0	0.0	0.0	0.0	1.8	13.5	2.6	186.0
42	OTHER MFGS	0.8	0.2	0.0	0.0	0.2	0.2	16.6	6.2	2.3	0.2
43	TRANSPORT	26.3	2.8	3.4	1.2	1.1	6.1	178.4	109.2	11.7	10.9
44	ELEC COMPY	31.9	1.3	0.2	3.8	0.6	9.1	134.6	87.0	20.7	4.4
45	GAS COMPY	3.8	0.4	0.8	1.4	0.4	0.6	28.2	17.6	3.1	-0.0
46	WATER SERV	2.4	0.2	0.4	1.2	0.2	2.8	11.1	11.3	4.2	-0.0
47	COMMUNICAT	53.2	6.0	3.8	1.4	5.3	17.8	142.0	122.7	14.4	3.4
48	P,O $ MISC	20.7	2.8	1.0	12.6	0.8	19.7	109.0	-0.0	235.8	18.8
49	HOUSING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.0	5.3	-0.0
50	HIGHWAYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0	107.2	-0.0
51	WHSLE$RET	38.7	3.6	4.2	3.2	3.9	44.9	303.8	1765.3	21.0	2.0
52	FINANCE	25.2	18.1	2.8	1.4	1.9	6.7	104.7	196.8	28.5	-0.0
53	INSURANCE	18.0	1.9	24.7	3.0	2.6	8.7	133.6	182.1	10.3	-0.0
54	REA ESTATE	29.0	4.7	5.0	7.0	3.0	21.7	71.2	79.9	0.2	-0.0
55	BUSI SERV	33.4	8.1	9.8	7.0	17.3	20.8	210.8	40.8	18.2	-0.0
56	PERS SERV	29.2	3.6	1.4	1.6	3.6	32.3	128.0	768.0	7.3	0.1
57	SUBTOTAL	410.2	62.1	63.9	57.0	47.0	221.9	3126.6	4280.9	604.4	1115.6
58	VAL ADDED	1835.3	275.0	377.7	99.3	225.7	626.8	9003.7	790.7	860.8	704.3
59	IMPORTS	23.9	0.9	2.1	0.1	22.5	103.3	4579.8	2175.8	410.8	-0.0
60	TOTAL	2269.4	338.0	443.7	156.4	295.2	952.0	16710.1	7247.4	1876.0	1819.9

TABLE V - 2

PROJECTED OUTPUT FLOWS BY INDUSTRY 1980

PUGET SOUND AND ADJACENT WATERS GROSS FLOWS TABLE 1980

		61 INVEST	62 EXPORTS	63 TOTAL
1	FIELD CROP	-0.0	-0.0	2.1
2	VEGETABLES	-0.0	-0.0	32.1
3	LVSTK$PROD	-0.0	-0.0	124.8
4	OTHER AGRI	-0.0	5.5	23.7
5	FISHING	-0.0	-0.0	16.5
6	MEAT PRODS	-0.0	58.0	233.0
7	DAIRY PROD	-0.0	27.0	194.0
8	CANN$PRES	-0.0	185.3	229.5
9	GRAIN MLLS	-0.0	50.5	142.7
10	BEVERAGES	-0.0	148.9	230.4
11	OTHR FOODS	-0.0	56.5	211.3
12	TEXTILES	0.6	3.9	7.1
13	APPAREL	-0.0	56.1	96.1
14	MINING	-0.0	6.7	35.6
15	FORESTRY	-0.0	1.9	26.3
16	LOGGING	-0.0	29.0	96.2
17	SAWMILLS	-0.0	10.0	70.5
18	PLYWOOD	-0.0	94.1	125.3
19	OTHER WOOD	-0.0	41.3	79.3
20	FURN$FIX	7.1	40.3	62.0
21	PULPMILLS	-0.0	22.0	69.2
22	PAPER MLLS	-0.0	314.3	352.9
23	PAPBD MILS	-0.0	188.3	261.0
24	PRINT$PUBS	-0.0	13.8	170.8
25	INDUS$CHEM	-0.0	40.9	45.8
26	OTHER CHEM	-0.0	36.8	92.8
27	PET REFINE	-0.0	172.2	511.8
28	GLASS$STONE	-0.0	10.1	32.3
29	CEM$CLAY	-0.0	18.4	140.2
30	IRON$STEEL	3.2	49.9	126.8
31	NONFER MET	-0.0	51.5	81.5
32	ALUMINUM	2.9	288.1	310.3
33	HEAVY METL	5.7	70.7	133.0
34	LITE METL	2.1	23.5	115.5
35	NONELC EQP	26.1	60.7	96.4
36	MACH TOOL	2.5	11.5	64.5
37	NONELC EQP	10.8	72.9	95.6
38	ELEC MACH	1.4	48.7	87.4
39	AEROSPACE	-0.0	3491.0	4396.4
40	MOTOR VEH	-0.0	157.4	166.1
41	SHIP BLDG	1.0	38.9	243.8
42	OTHER MFGS	5.6	39.4	70.3
43	TRANSPORT	7.4	243.0	560.6
44	ELEC COMPY	-0.0	2.4	249.1
45	GAS COMPY	-0.0	0.4	49.3
46	WATER SERV	-0.0	-0.0	26.6
47	COMMUNICAT	-0.0	24.7	307.2
48	P,O $ MISC	276.8	3.9	644.3
49	HOUSING	523.0	-0.0	594.3
50	HIGHWAYS	-0.0	13.9	121.1
51	WHSLE$RET	16.5	160.8	2269.4
52	FINANCE	-0.0	8.0	338.0
53	INSURANCE	-0.0	117.7	443.7
54	REA ESTATE	4.8	0.3	155.4
55	BUSI SERV	-0.0	25.4	295.2
56	PERS SERV	-0.0	48.6	952.0
57	SUBTOTAL	897.5	6685.1	16710.1
58	VAL ADDED	-0.0	-0.0	11359.5
59	IMPORTS	347.6	-0.0	7514.0
60	TOTAL	1245.1	6685.1	35583.6

a. Industry Output Changes—Two industries show a rather substantial increase in projected output; aerospace and aluminum. The aerospace projection was discussed in the previous chapter but requires further comment. To begin with, it should be noted that a substantial increase in output since 1963 has already occurred. In addition, the national projection used in this study projects a 35 percent increase in aerospace output but only a 12 percent increase due to Federal demands. Thus, the increase in demand for the private market is projected at well over 35 percent. Since the aerospace industry in the PS&AW area is relatively more concentrated in private market products—commercial aircraft—this supports a dramatic increase. Another point should be mentioned: the national projection upon which this study has drawn are a year or two old. It now appears that most forecasts of commercial aircraft demand were too conservative.

The rapid increase in aluminum output merely reflects a small starting base. The addition of the Intalco plant after 1963 and expected future growth combine to explain the large percentage increase. Some industries shown in Table V-2 show declines, or less growth than one might expect. Agricultural industries, as mentioned before, are limited by supply constraints. The major constraint is the supply of agricultural lands. The demand for housing gobbles up available land. As one student put it, "People are driving out cows."

Shipbuilding and Repairing, Industry 41—recall that this includes the Bremerton Navy Yard—shows relatively small growth. Most of the output of this industry in 1963 went to the Federal Government, and the source used in this study indicates no increase in Federal procurement in 1980 over 1963. For this reason the projected output is not much increased over 1963. Recent events do suggest that this may be low and that a locational shift may be favoring this area. If so, a higher figure may be warranted. Unhappily from a projectors viewpoint, this industry is not only subject to changes in defense needs but general maritime policy changes as well. So, the shipbuilding and repairing figure is not one we shall defend to the last IBM punchcard.

Industries 43 through 56 are primarily oriented towards the local markets, consumers, investors and state and local governments do not show wide variations in output growth rates. Such differences as do exist are largely explicable in terms of changing pattern of consumer demand as per capita income increases—as discussed in Chapter IV. For example, with higher incomes, the spending on communications, Industry 47, rises more than proportionately.

b. Market Structure Changes—Changes in the importance of the various markets are of interest. In 1963 the Federal Government's demand accounted for some $1.1 billion of the area's industry output—about 14 percent. (See Row 57, Column 60, in Table III-3). In 1980 this source of demand still accounts for $1.1 billion. However, this is only 6.5 percent of the total. A small part of this relative decline is related to the inclusion of some Federal activities such as the Post Office, in the state and local government column in 1980. Nevertheless, the major portion of the decline results from a shift away from regional dependence on defense spending.

If the reader will jiggle pages back and forth with us, some interesting changes in consumer spending can be shown. Spending for consumption, as shown in Column 58 of Table V-2, will increase to $7.2 billion in 1980. Of this amount, $2.2 billion, Row 59, represents spending on goods and services produced outside of the area. In 1963 imported goods accounted for some 29 percent of consumer purchases (flip back to Table III-3, Row 59, Column 58). In 1980 the total for purchases of imported goods and services stands at 27 percent (Table V-2, Row 59, Column 58).

The fact that the import ratio remained about the same, reflects two offsetting tendencies. As per capita incomes rise, there is an overall tendency in the PS&AW area to spend relatively more on goods produced outside the area, especially durables. On the other hand, as the area grows in economic size, it tends to supply more goods locally: that is, import substitution occurs. These two effects have just about offset each other.

Turning to interindustry sales (Row 57, Column 57), in 1963 this amounted to $1.7 billion out of $7.9 billion, or 22 percent of total sales. Table V-2 for 1980 shows $3.1 billion out of $16.7 billion, or 19 percent delivered to interindustry purchasers. This is not quite what one might expect. As with consumer goods, usually as an area grows, it supplies relatively more from within. Even though import substitution was built into the estimates, it was not enough to offset a countervailing force. The fact that two of the largest growth industries, aerospace and aluminum, purchase relatively few of their inputs locally, means a smaller percentage growth in interindustry sales.

In general, Table V-2, especially when compared with Table III-3, clarifies the detailed changes in the economic structure of the area. Since it is patently impossible to review each entry, the reader is encouraged to study these at his leisure. In such a review, however, we do suggest that the definitions and qualifications noted in the previous chapter be kept in mind.

c. Large Water Using Industries—Since a major use of this study is in water resource planning, the general reader will pardon a provincial look at the projections for the large water using industries. Growth in output of the seven large water using manufacturing industries is shown in Figure V-2. Paper and allied products, chemicals, and primary metals are projected to have the highest rates of growth. (Primary metals, please note, includes aluminum). The relatively large increase in output of paper and allied products is in line with national projections for this industry. The high increase in chemicals output is due in part, to a large projected manufacturing demand within the area. On the lower growth side, food and kindred products, and lumber and wood, are both somewhat limited on the supply side.

Table V-3 gives the direct and indirect ties of each of the large water using industries to the five final markets in 1980. (This is similar to Table III-4 above and is to be interpreted in the same manner). Lumber and wood products, paper and allied products, primary metals, and (to a lesser degree) chemicals have their major share of sales tied directly or indirectly to the export market. Food and kindred products and petroleum are relatively more oriented toward the consumer market. Stone, clay, and glass, as expected, relate heavily to investment.

The North, Central, and West Divisions: 1980

A comprehensive description of projected growth in the divisions is given in Tables V-4a, b and c. Three measures of activity are shown for each division: output, value added, and employment. In order to facilitate comparisions, the 1963 data are also shown. Since there is no reason to presume any regional difference, the value added and employment estimates are just about proportional to the output relations. Unfortunately, problems of disclosure do not permit the inclusion of more detail.

a. The North Division—In terms of both increased total output and Gross Regional Product, the North division shows the greatest percentage increase. Employment is projected to rise some 27 percent. The fact that this later rise is less than that for the overall area is because of the greater productivity increases in the North's industries. The population increase appears somewhat less than expected on the basis of increased employment. However, 1963 was not a particularly good year for the North and part of the employment increase merely absorbs unemployed without adding new families.

The big growth industries in the North are aluminum, part of primary metals, pulp and paper, and government employment. In the later category, higher education will play a sizeable role.

Because discussion of aluminum expansion has been in the press recently, it should be made clear that this study assumes continued growth in this industry. Discussions with industry experts indicate that the location is a "natural" for additional growth. Whether this takes the form of new firms or added output by existing establishments is not germane, but we do assume growth one way or another.

TABLE V-3. Large water using manufacturing industries, projected output tied directly and indirectly to final markets—Puget Sound and Adjacent Waters, 1980—(Millions of 1963 dollars)

Industry	Sales to Consumption	Sales to State & Local Government	Sales to Investment	Sales to Government	Sales to Exports	Total Output
Food & kindred products	595.8	50.3	0.2	17.7	576.8	1,240.8
Lumber & wood products	21.2	24.1	59.0	6.8	260.4	371.5
Paper & allied products	52.1	9.3	3.1	1.8	616.9	683.2
Chemicals	17.1	5.9	7.5	2.1	105.9	138.5
Petroleum	223.0	29.5	16.5	11.3	231.5	511.8
Stone, clay & glass	27.1	32.8	57.9	4.3	50.5	172.6
Primary metals	6.7	13.6	28.0	7.8	462.8	519.9

LARGE WATER USING MANUFACTURING INDUSTRIES

1963 & PROJECTED 1980 OUTPUT PUGET SOUND & ADJACENT WATERS

(output in millions of dollars)

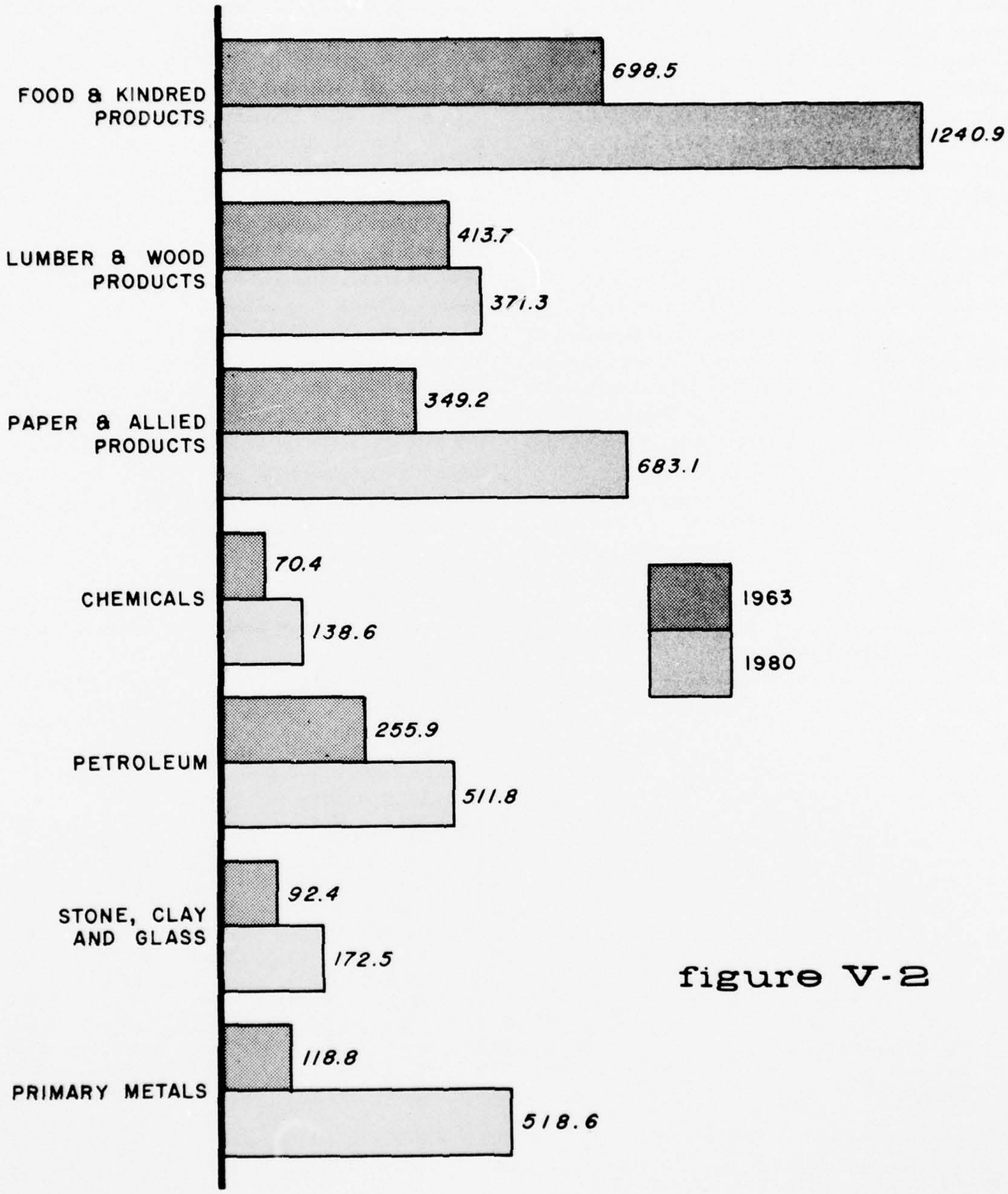


figure V-2

There is a final point to be made with respect to the North division—admittedly not an awfully scientific one. One has the feeling, both as a result of personal knowledge of the area and general locational factors, that the projections for the North could turn out to be too conservative—and perhaps by quite a margin. Why? A combination of: waterfront resources amenable for developing international and intercoastal trade, proximity to a growing Vancouver, British Columbia, and amenities to satisfy a growing tourist market. Thus, this division bears watching.

b. The Central Division—There really is not much to say about the projections for the Central division that has not already been mentioned. After all, with almost 90 percent of the area's activity taking place in this division, whatever was said about the area really implies this division. There are, however, a few points that should be mentioned.

While agricultural employment is projected to decline throughout the whole PS&AW area, its major decline will be in the populous Central division as shown in Tables V-4a, b and c. The demand for land for urban living, of course, is the main reason for this decline, both absolute and relative.

A second factor concerning the Central division relates to the service industries, either industries 43 to 56 in Table V-3 or 17 to 21 in Tables V-4a, b and c. The Central division is not a large exporter of services. Yet in projecting to 1980, there is reason to believe the growth of service activities may be understated. A large part of the understatement may originate in the misclassification of service industry jobs rather than services as manufacturing. For example, much of the research and development activity classified as manufacturing, really belongs in the service category. As the reader can imagine, it is not always possible to distinguish one industry classification from another.

c. The West Division—Major growth strength in the West is drawn from the pulp and paper products component of the forest products industry. As with the North division, added strength will come from increasing tourism and, summer home growth. The location of a new four-year state college in the Olympia area is projected to give added growth to the area.

At the time of the study, there is considerable discussion as to the possibilities of a bridge or bridges across the Puget Sound as a supplement to or partial replacement of the ferry system. Such a development will have an impact on the West division although the impact is expected to be more in terms of suburban living than a relocation of industry. If such a bridge or bridges are constructed, it means our population projection is on the low side.

TABLE V-4a. Subregional output by industry: 1963 and projected 1980, Puget Sound and Adjacent Waters (millions of 1963 dollars)

		1963 Output			1980 Output		
No.	Industry	North Region	Central Region	West Region	North Region	Central Region	West Region
1	Agri., For., Fish., & Mining	21.2	167.8	7.8	72.8	163.1	25.2
2	Food & Kindred Products	73.1	578.6	46.7	137.3	1,014.5	89.1
3	Lumber & Wood Products	51.7	278.8	83.2	58.8	234.9	77.6
4	Paper & Allied Products	43.7	229.0	76.4	108.0	398.4	176.7
5	Chemicals	1.2	67.5	1.7	2.4	133.0	3.2
6	Petroleum Refining	209.6	46.3	*	448.0	63.8	*
7	Stone, Clay & Glass	9.0	82.2	1.1	18.0	152.8	1.7
8	Primary Metals	0.2	118.6	*	249.3	269.2	0.1
9	Other Non-Durable Mfgrs.	5.4	161.4	2.0	8.9	331.7	3.7
10	Other Durable Mfgrs.	22.6	1,787.8	5.4	40.6	5,409.6	10.5
11	Trans., Com., & P.V.	41.8	548.2	25.8	90.4	1,055.9	46.5
12	Whsle. & Retail Trade	50.0	1,164.0	36.3	124.0	2,094.8	50.6
13	Services	55.9	1,045.2	48.3	95.2	2,035.1	55.6
14	Construction	33.7	621.9	18.2	70.9	1,237.7	51.1
	Total	619.1	6,897.3	352.9	1,524.6	14,594.4	591.6

Note: Figures may not add to totals due to rounding.

*Negligible, implies less than $50,000.

TABLE V-4b. Subregional value added by industry: 1963 and projected 1980, Puget Sound and Adjacent Waters (millions of 1963 dollars)

		1963 Value Added			*1980 Value Added*		
No.	Industry	North Region	Central Region	West Region	North Region	Central Region	West Region
1	Agri., For., Fish., & Mining	11.1	83.0	5.4	38.9	87.6	12.5
2	Food & Kindred Products	22.7	179.1	21.5	44.8	331.4	29.1
3	Lumber & Wood Products	21.9	117.6	35.1	24.5	97.8	32.3
4	Paper & Allied Products	19.6	111.7	36.8	53.0	195.3	86.6
5	Chemicals	0.6	32.7	0.6	1.2	65.6	1.6
6	Petroleum Refining	50.4	11.1	*	107.7	15.3	*
7	Stone, Clay & Glass	3.3	34.2	0.4	7.4	63.0	0.7
8	Primary Metals	0.1	53.5	*	104.2	112.5	*
9	Other Non-Durable Mfgrs.	2.4	88.4	1.2	4.9	180.7	2.0
10	Other Durable Mfgrs.	13.0	944.1	2.5	17.9	2,386.1	4.6
11	Trans., Com., & P.V.	30.1	412.1	18.9	67.8	791.9	34.9
12	Whsle. & Retail Trade	40.5	941.5	29.3	100.3	1,694.1	41.0
13	Services	39.5	768.3	34.4	69.9	1,493.8	40.8
14	Construction	13.9	255.7	7.4	29.1	508.7	21.0
15	Government	51.4	623.9	58.7	108.0	1,296.3	160.8
16	Consumption	48.6	514.9	37.3	68.8	692.7	29.3
	Total	369.1	5,171.8	289.5	848.4	10,012.8	497.2

Note: Figures may not add to totals due to rounding.

*Negligible, implies less than $50,000.

TABLE V-4c. Subregional total employment by industry: 1963 and projected 1980, Puget Sound and Adjacent Waters

		1963 Employment			1980 Employment		
No.	Industry	North Region	Central Region	West Region	North Region	Central Region	West Region
1	Agri., For., Fish., & Mining	7.1	14.0	2.6	6.0	9.9	2.3
2	Food & Kindred Products	2.4	12.6	0.9	2.2	15.9	1.4
3	Lumber & Wood Products	2.1	13.1	4.4	1.5	5.2	1.7
4	Paper & Allied Products	1.1	6.8	1.5	2.3	8.5	3.8
5	Chemicals	*	2.2	0.1	*	1.8	*
6	Petroleum Refining	1.0	0.2	*	1.2	0.2	*
7	Stone, Clay & Glass	0.4	3.3	0.1	0.5	4.5	0.1
8	Primary Metals	*	4.1	*	3.5	3.8	*
9	Other Non-Durable Mfgrs.	0.7	13.8	0.5	0.5	19.0	0.2
10	Other Durable Mfgrs.	0.8	85.2	0.2	1.3	174.0	0.3
11	Trans., Com., & P.V.	2.1	36.7	1.5	2.7	32.1	1.4
12	Whsle. & Retail Trade	8.3	125.3	6.3	11.1	187.0	4.5
13	Services	8.4	128.3	7.3	10.0	214.2	5.9
14	Construction	2.8	36.3	2.1	2.8	49.6	2.0
15	Government	8.3	97.2	10.2	12.3	147.5	18.3
	Total	45.5	579.1	37.7	57.9	873.2	41.9

Note: Figures may not add to totals due to rounding.

*Negligible, implies less than 50 employees.

PROJECTIONS: 2000 AND 2020

The projections to 2000 and 2020 for the overall PS&AW area and the divisions are summarized in the impact on population growth as shown in Figure V-5. The age-sex combination of the population is shown in Table V-5. As compared with 1963 and 1980, 2000 and 2020 do, indeed, spell out something equivalent to a Pugetopolis.

Overall Region: General Indicators

Overall population is projected to pass the 6.8 million figure and each of the divisions is projected to at least double in population. The growth in the various industries is shown in Table V-6. As in the earlier period, growth in output and value added is projected to outstrip employment growth because of productivity gains. Looking at the 2020 projections of overall magnitudes, associated with the projections of a 6.8 million population is an overall employment level of 2.4 million people. Gross Regional Product is estimated to reach $68 billion. While this may seem astronomical, it represents only 1.45 percent of projected United States Gross National Product.

Gross Regional Product per capita, estimated to be $3,100 in 1963 and $4,200 in 1980, is projected to rise to $6,400 in 2000 and $10,000 in 2020. Again, these may appear high. However, these estimates over a 57 year period from a 1963 base

TABLE V-5. Projected age-sex compositions, Puget Sound and Adjacent Waters (in 000's)

	1980			2000			2020		
Age Bracket	Total	Male	Female	Total	Male	Female	Total	Male	Female
0-14	863.1	442.8	420.3	1,361.1	698.2	662.9	2,155.2	1,105.6	1,049.6
15-59	1,494.9	753.4	741.5	2,357.5	1,188.2	1,169.3	3,732.9	1,881.4	1,851.5
60 & Over	368.9	163.8	205.1	581.9	258.4	323.5	921.3	409.1	512.2
Total	2,726.9	1,360.0	1,366.9	4,300.5	2,144.8	2,155.7	6,809.4	3,396.1	3,413.3

TABLE V-6. Projected output, value added and employment by industry 2000 and 2020, Puget Sound and Adjacent Waters *(output and value added in millions of 1963 dollars)*

		2000			2020		
No.	Industry	Output	Value Added	Employment	Output	Value Added	Employment
1	Agri., For., Fish., & Mining	360.0	190.0	13.5	516.0	268.0	11.0
2	Food & Kindred Products	2,333.4	900.2	22.9	4,088.7	1,906.6	25.6
3	Lumber & Wood Products	305.5	146.0	2.8	234.2	136.0	0.9
4	Paper & Allied Products	1,009.4	561.0	15.9	1,101.5	705.1	12.4
5	Chemicals	287.0	170.4	1.4	553.7	420.2	1.0
6	Petroleum Refining	1,080.2	301.4	1.4	2,124.7	729.1	1.3
7	Stone, Clay & Glass	337.1	161.2	6.5	614.0	361.1	8.0
8	Primary Metals	885.3	392.1	8.7	1,408.5	699.8	9.9
9	Other Non-Durable Mfgrs.	740.8	468.6	25.2	1,485.6	1,155.8	30.9
10	Other Durable Mfgrs.	18,707.1	7,707.4	380.7	58,086.5	24,349.1	787.4
11	Trans., Com., & P.V.	2,422.7	1,990.8	29.7	4,585.6	4,373.5	23.3
12	Whsle. & Retail Trade	4,267.4	4,006.3	292.3	7,477.7	8,634.1	402.4
13	Services	4,356.0	3,711.8	388.8	8,088.8	8,477.0	627.3
14	Construction	2,869.9	1,395.9	70.5	5,644.7	3,442.6	87.2
15	Government	--	4,140.9	275.1	--	10,816.5	405.8
16	Consumers	--	1,191.6	--	--	1,773.0	--
	Total	39,961.8	27,435.6	1,535.4	96,010.2	68,247.5	2,434.5

Note: Figures may not add to totals due to rounding.

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POPULATION BY REGION, 1963 AND PROJECTED 1980, 2000 & 2020

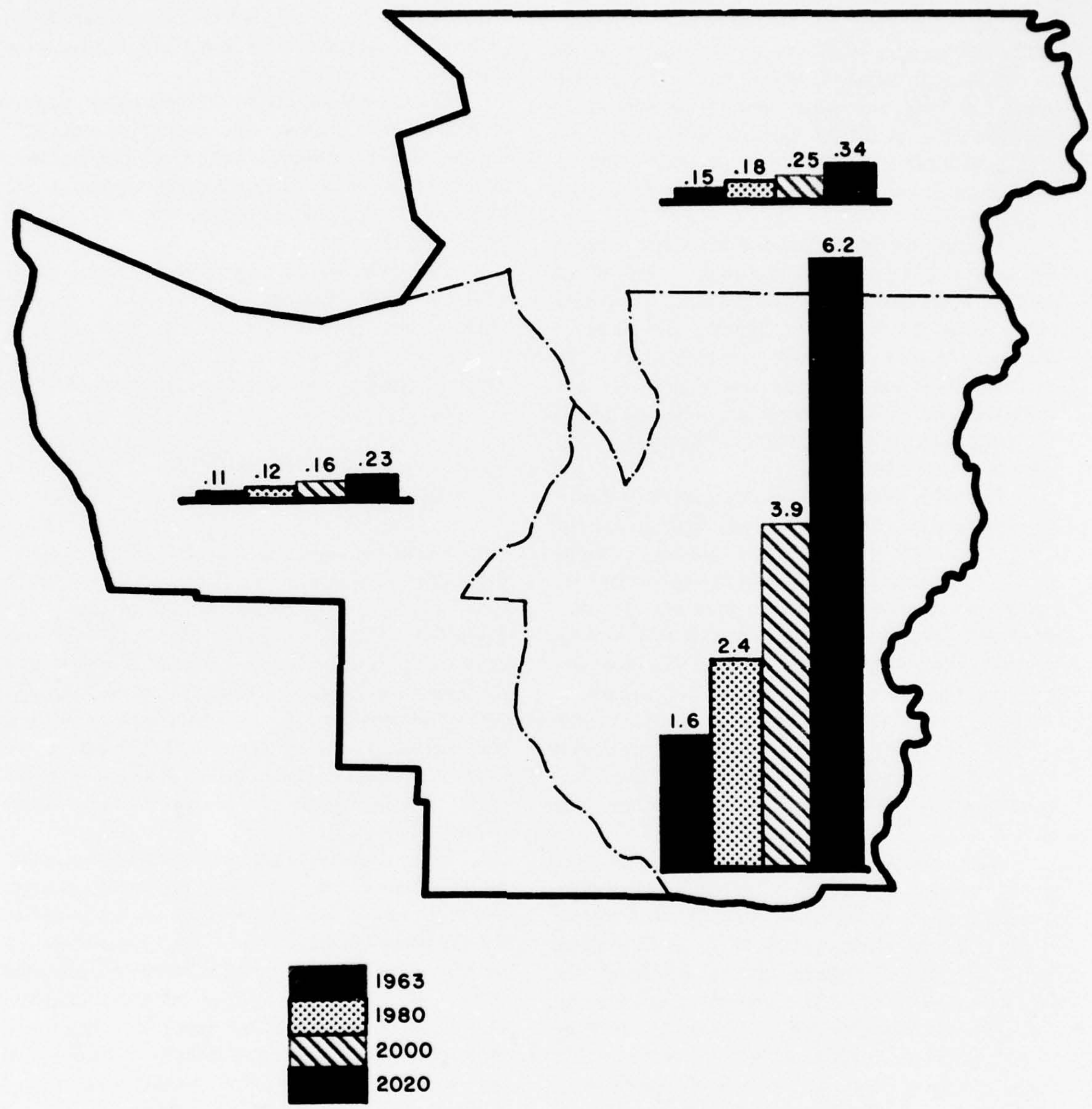

figure V-3

represent a compound interest growth rate of only 2.0 percent per year.

Overall Region: Industry Growth and Interpretation

The projected growth in the various industries is also shown in Table V-6. As can be seen, the major source of growth originates in the other durable manufacturing industry. Other sources of growth appear in pulp and paper and an assortment of manufacturing industries. Lumber and wood along with agriculture are projected to decline in employment because of resource limitations and increased productivity.

Clearly, the projections for any single industry are subject to a fair possibility of error. Part of the problem is the changing mix of products. The reader can visualize the problem by thinking back 53 years and trying to project to 1967, given the data available in 1914. What output would one project for television sets, jet engines, computers, or frozen pizza? The point, of course, is that strict industry classifications are not feasible.

Perhaps a better way to interpret the industry projections is to think of the many firms in each of these industries growing and producing a whole variety of products. In this light the projections are interpreted as saying that the firms now in these industries will grow to a certain size. It may well be, however, that many of their products will no longer belong in the old industry category. For example, in 1914 if one were projecting the growth of the General Motors Corporation to 1967, a projection based solely on automobile demand would have been quite low GM produces numerous products and services.

Along the same vein, the projected growth in manufacturing output, value added and employment as a percentage of the various totals, should also be interpreted with some caution. In terms of employment, for example, manufacturing accounted for about 24 percent of total employment in 1963. By 2020 the manufacturing share is estimated to increase to 35 percent. Once again, we remind the reader that many of these jobs are not actually involved in production work. They represent research and development, clerical, sales and other types of white collar employment.

The North, Central and West Divisions

The growth in output, value added and employment in each of the divisions is shown in Tables V-7a, b and c. The overall pattern reflects the past and projected 1980 trends.

The North division is projected to have continued growth based on expanding employment opportunities within the area. Allowance has also been made for an increased population of commuters. This is especially the case in Island County where the spillover of suburbs from the Central division is expected to be substantial.

The Central division with projected population of almost seven million, will continue to dominate the overall area. Continued declines in employment in lumber and wood products, along with agriculture are projected for the land use squeeze will be the hardest in this division.

The West division is projected to grow somewhat less rapidly than the other areas, especially in terms of employment. However, as noted before, a cross-Sound bridge can increase the suburban component, especially in Mason and possibly Jefferson counties.

PROJECTIONS: EVALUATION AND UTILIZATION

About the safest statement one can make about projections is that they are bound to be wrong at least as a matter of degree. While this report has developed a set of projections, we would rather not consider them as final. For both public and private planning needs, it is much wiser to think in terms of a projection process. As new information or new planning needs arise, modifications of the data can be introduced. This is precisely one of the reasons the input-output method was chosen, it allows for adaptability.

In this section some of the potential uses and modifications of the data developed are considered. Naturally, not all uses can be suggested. Yet some feel for the potential, can be given. More specifically, we consider how the data can be utilized to measure the impact of changes in one or another industry's output. Next, the case of the impact of a brand new industry's impact is discussed. Finally, in conjunction with additional data, we look into the utilization of our findings for more specific planning purposes.

Industry Impact Analysis

Industry impact analysis asks what is the impact of changes in the output of one industry on the economy of the area? Suppose, for example, that

TABLE V-7a. Projected subregional output by industry by region 2000 and 2020 (millions of 1963 dollars)

No.	Industry	2000 Output North Region	2000 Output Central Region	2000 Output West Region	2020 Output North Region	2020 Output Central Region	2020 Output West Region
1	Agri., For., Fish., & Mining	100.7	226.7	32.4	144.5	325.1	46.4
2	Food & Kindred Products	258.1	1,907.7	167.6	452.3	3,342.7	293.7
3	Lumber & Wood Products	48.4	193.3	63.8	37.1	148.2	48.9
4	Paper & Allied Products	159.7	588.7	261.0	174.2	642.4	284.9
5	Chemicals	5.0	275.4	6.6	9.6	531.4	12.7
6	Petroleum Refining	945.5	134.7	*	1,859.8	264.9	*
7	Stone, Clay & Glass	35.1	298.6	3.4	64.0	543.9	6.2
8	Primary Metals	425.6	459.5	0.2	677.1	731.1	0.3
9	Other Non-Durable Mfgrs.	19.2	713.7	7.9	38.5	1,431.2	15.9
10	Other Durable Mfgrs.	139.2	18,532.0	35.9	432.1	57,542.9	111.5
11	Trans., Com., & P.V.	183.7	2,144.6	94.4	347.6	4,059.2	178.7
12	Whsle. & Retail Trade	233.1	3,939.0	95.2	408.5	6,902.3	166.9
13	Services	189.7	4,055.4	110.9	352.3	7,530.6	205.9
14	Construction	149.7	2,612.4	107.8	294.5	5,138.2	212.1
	Total	2,892.7	36,081.7	987.1	5,292.1	89,134.1	1,584.1

Note: Figures may not add to totals due to rounding.

*Negligible, implies less than $50,000.

TABLE V-7b. Projected subregional value added by industry by region 2000 and 2020 (millions of 1963 dollars)

No.	*Industry*	2000 Value Added North Region	2000 Value Added Central Region	2000 Value Added West Region	2020 Value Added North Region	2020 Value Added Central Region	2020 Value Added West Region
1	Agri., For., Fish., & Mining	53.1	119.5	17.1	75.1	169.0	24.1
2	Food & Kindred Products	99.6	736.0	64.7	210.9	1,558.7	137.0
3	Lumber & Wood Products	23.1	92.4	30.5	21.5	86.0	28.4
4	Paper & Allied Products	88.7	327.2	145.1	111.5	411.2	182.4
5	Chemicals	3.0	163.5	3.9	7.3	403.3	9.6
6	Petroleum Refining	263.8	37.6	*	638.2	90.9	*
7	Stone, Clay & Glass	16.8	142.8	1.6	37.6	319.9	3.6
8	Primary Metals	188.5	203.5	0.1	336.4	363.3	0.1
9	Other Non-Durable Mfgrs.	12.1	451.4	5.0	29.9	1,113.5	12.4
10	Other Durable Mfgrs.	57.3	7,635.3	14.8	181.1	24,121.2	46.7
11	Trans., Com., & P.V.	150.9	1,762.3	77.6	331.6	3,871.5	170.5
12	Whsle. & Retail Trade	218.9	3,698.0	89.4	471.7	7,969.8	192.7
13	Services	161.7	3,455.6	94.5	369.2	7,892.0	215.8
14	Construction	72.8	1,270.6	52.4	179.6	3,133.7	129.3
15	Government	285.8	3,429.7	425.3	746.6	8,958.9	111.0
16	Consumers	103.6	1,043.9	44.1	154.2	1,553.2	65.6
	Total	1,799.7	24,569.3	1,066.1	3,902.4	62,016.1	1,329.2

Note: Figures may not add to totals due to rounding.

*Negligible, implies less than $50,000.

TABLE V-7c. Projected subregional total employment by industry by region 2000 and 2020 (employment in 000's)

No.	Industry	2000 Employment North Region	Central Region	West Region	2020 Employment North Region	Central Region	West Region
1	Agri., For., Fish., & Mining	5.3	6.6	1.6	4.7	4.8	1.5
2	Food & Kindred Products	2.5	18.7	1.6	2.8	20.9	1.8
3	Lumber & Wood Products	0.4	1.8	0.6	0.1	0.6	0.2
4	Paper & Allied Products	2.5	9.3	4.1	2.0	7.2	3.2
5	Chemicals	*	1.3	*	*	0.9	*
6	Petroleum Refining	1.2	0.2	*	1.2	0.2	*
7	Stone, Clay & Glass	0.7	5.8	*	0.8	7.1	0.1
8	Primary Metals	4.2	4.5	*	4.8	5.1	*
9	Other Non-Durable Mfgrs.	0.7	24.3	0.3	0.8	29.8	0.3
10	Other Durable Mfgrs.	2.8	377.1	0.7	5.9	780.1	1.5
11	Trans., Com., & P.V.	2.3	26.3	1.2	1.8	20.6	0.9
12	Whsle. & Retail Trade	16.0	269.8	6.5	22.0	371.5	9.0
13	Services	16.9	362.0	9.9	27.3	584.0	16.0
14	Construction	3.7	64.2	2.7	4.5	79.4	3.2
15	Government	19.0	227.9	28.3	28.0	336.1	41.7
	Total	78.2	1,399.8	57.5	106.7	2,248.3	79.4

Note: Figures may not add to totals due to rounding.

*Negligible, implies less than 50 employees.

as new data develop it appears that our projected sales to the Federal Government of shipbuilding, Industry 41, in 1980 are 10 percent too low. Since projected sales to the Federal Government are $186 million (Table V-2, Row 41, Column 60), this means $18.6 million should be added to the figure. But how do we account for this impact?

One thing should not be done; simply add $18.6 million to total output. This will not account for the impact on other industries and will be inconsistent with input-output analysis. All one has to do is go to the table of direct and indirect impact given in the Technical Appendix. By multiplying every entry down the shipbuilding column by $18.6 million, the direct and indirect impact on each industry is calculated. (The economic rationale for this was discussed in Chapter IV). This kind of adjustment, of course, assumes that the pattern of inputs needed will be the same for the expanded output as for the already projected output. This is a reasonable assumption. But what does one do if a brand new industry appears on the scene? For here no past input pattern is relevant.

New Industry Analysis

Suppose a new industry announces the opening of a large plant in the PS&AW area. To keep the discussion perfectly abstract, pretend they plan to manufacture "incabulators." How do we introduce this industry into the projections?

The first step, as expected, is to find out as much about the new firm as possible—what are the projected levels of output, where and to whom is the product sold and where and from whom are the inputs produced? In other words, for this new industry develop an output row and an input column. For the time being, just add this new row and column to the existing table, Table V-2.

The next step is to look across the row at "incabulators" output sold to other industries in the PS&AW, to consumers, investors and local governments in the area. Now ask whether the purchase by these PS&AW industries and markets will come at the expense of other products produced locally or imported products or a combination of the two. If they are presumed to substitute for imports, for example, subtract the dollar value of the purchasers of incabu-

lators imports. Why go through all this mess? If it is not done adding purchases of incabulators to already existing purchasers will make input spending greater than output values. That does not make sense—unless one is intent on going broke. This step puts the rows in balance.

Input-output, also requires adjusting the columns. Again, why? Suppose one of the inputs to be purchased within the PS&AW area by the incabulator firm is $1 million of aluminum. As far as the aluminum industry is concerned, they need to produce $1 million more of output. To the aluminum industry, this is just the same as if they sold another $1 million to exports or the Federal Government. Thus, the impact of increased aluminum output is handled in the same way as the increase in shipbuilding discussed above. The same process should also be carried out for all other inputs purchased by the new incabulator industry.

Admittedly, all this is a bit technical and we have not spelled out all of the steps in detail. The whole point, of course, is that the input-output framework is perfectly adaptable to new industries. Further, it has the advantage that it forces consideration of the impact on other industries and provides a device for measuring this impact.

Specific Planning Purposes

The projections developed here are general in the sense that they provide output, value added and employment information on each industry. For more specific planning purposes, these data can be used in conjunction with other data for specific planning purposes. A few examples will indicate the potentials.

In water use planning for example, it is most desirable to know the quantities of water needed as input per unit of output. This is the reason special attention was paid to large water using industries. It is possible to extend the analysis by developing water use coefficients. These show how many gallons or acre-feet of water are needed per dollar of output. It is easiest to think of a new row across the bottom of Table V-2 showing, for each industry, these coefficients. By multiplying these coefficients by the projected output levels, we get an estimate of water needs. Further, all of the impact of changes discussed above can be translated in changes in water demands. Naturally, this does not tell the whole story of water demand, but it helps.

For land use planning, just as water use coefficients can be developed, land use coefficients can be estimated. How many square feet of land are needed per dollar of output is the question land use coefficients answer. Utilizing these in conjunction with output projections gives a picture of the overall land use demands.

For the purpose of forecasting state and local revenues, tax coefficients can be developed. These show the various taxes paid by industry and consumers per dollar of output or spending. Since some taxes, such as the motor vehicle tax, bear more heavily on some industries than others, changes in the structure of the area's industries will change the tax yield. Thus, in forecasting tax revenues, not only is the area's overall level of output important, but also the area's industry structure.

Finally, how about the private market. The marketing department of a firm or those involved in investment decisions also must plan. Here by comparing themselves with the industries of which they are a part, the firm can see how they share in the present market. Further, by looking at the projected growth, the firm can evaluate their potentials in various markets.

In this regard, Table III-4 and its equivalent shown in the Technical Appendix for 1980 are also of interest. These tables show the ultimate markets for products. For firms who sell a substantial amount of their output to other industries in the area, these tables suggest the ultimate sources of demand. It is even possible for a firm to insert itself into one of these tables and thus see the implications of economic interrelation quite specifically on their specific products. All these uses, of course, do not replace marketing or investment analysis. They merely provide a supplement.

ACKNOWLEDGEMENTS

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The study director was Dr. Charles M. Tiebout. Since some of the techniques developed in this study are of general research interest, parts of the analysis were carried out under a subcontract to the University of Washington. The University is currently investigating alternative techniques for regional forecasting under a grant from the Economic Development Administration, United States Department of Commerce. Thus, some of the findings of that study provided useful inputs to this analysis and vice versa.

During various phases of the study, advice and comments were given by: Dr. Charles Leven, Director, Institute for Urban and Regional Studies, Washington University (St. Louis); Dr. David Houston, Professor of Economics, University of Pittsburgh; Dr. Bernard Udis, Director, Bureau of Economic Research, University of Colorado; and especially Dr. Philip Bourque, Professor of Business Administration, University of Washington. We are grateful for this counsel.

Consulting Services Corporation is particularly pleased to be able to report our findings in greater industry detail than called for in our contract. In part, this reflects the fine cooperation we have received from the various parties mentioned above.

GLOSSARY OF TERMS USED

(In order referred to in text)

Standard Industrial Classification (SIC)—Revised in 1957 by the Federal Bureau of the Budget, it defines industry groups by their product or services. See Standard Industrial Classification Manual, Executive Office of the President, Bureau of the Budget, 1957.

Input-Output Analysis—This term is used interchangeably with interindustry analysis. It connotes a specific framework or model in which ties between industries and their markets are stressed. See the text and bibliographic references for further details.

Value Added—As used here a firm's sales (adjusted for inventory changes) less the purchases of goods and services from other firms. It is equivalent to the firm's contribution to gross regional product. It differs from the term as used in the Census of Manufactures in that the census does not subtract purchases of services from sales.

Output—Except for those industries where a "margin" entries are used, this is equivalent to sales.

Margins—In the case of wholesale, retail, banks, insurance and real estate, it represents the markup costs involved in producing the service. In the case of a retail clothing store, the cost of wages, wrapping paper, lighting and so forth would be included, but not the cost of the clothes.

Direct Coefficients—The cents worth of inputs of product $\underline{i}$ needed per dollar of output of product $\underline{j}$.

Indirect Impact—The impact on industries in the area of a change in output in a given industry. This excludes any effect of consumer investment or state and local government spending.

Induced Impact—The impact on the economy of increased consumer income, investment and state and local government spending.

Labor Force Participation Rate—The percentage of the population in the labor force. At any point in time it is equal to total employment plus unemployment, which makes up the civilian labor force, divided by population.

SOURCES OF DATA AND SELECT BIBLIOGRAPHY

GENERAL SOURCES

Employment Data—Employment figures are taken from the Washington Department of Employment Security. For the year 1963, these estimates of covered employment were supplemented by our own estimates to generate total employment data. National data were taken from the Bureau of Employment Security and the Census of Manufactures, 1963.

1963 Input-Output Data—The State of Washington Input-Output Study was carried out by a team of investigators at the University of Washington under the direction of Professor Philip Bourque. In addition to the report filed with the sponsor—the Washington Department of Commerce and Economic Development—additional data from that study were made available. The results of the study are presented in; Philip Bourque, et al, The Washington Economy: An Input-Output Study, Published by the Graduate School of Business Administration, University of Washington, and the Department of Commerce and Economic Development, State of Washington, 1967.

National Projections—The major source of data on national projections are contained in Clopper Almon, *The Structure of American Industry to 1975*, (New York: Harper and Row, 1966). While this book was in press, Dr. Almon extended his projections to 1980, as an aid to the Economic Development Administration, United States Department of Commerce. These projections were, in turn, utilized as a basic source by Dr. Curtis Harris, formerly of the Economic Development Administration. Dr. Harris, regrouped the data in a manner consistent with Census of Population industry detail and allocated these to the fifty states. We are extremely grateful to Dr. Almon and Dr. Harris for permission to use their data.

In late December, 1966, the Bureau of Labor Statistics released, Projections 1970: Interindustry Relationships, Potential Demand, Employment, U.S. Department of Labor, Bulletin No. 1536. Prior to that, Mr. Jack Alterman, Director, Economic Growth Studies, was kind enough to provide us an advance copy of that study. This report was of major assistance in estimating consumption tendencies. World trade projections relied upon a staff working paper by Evelyn Parrish for U.S. Department of Commerce. Since it is a staff paper, no further citation can be given.

Specific Industry Data—Below are listed for the industries named at the left specific sources of data used in the projections for these industries.

Industry 1-4, Agriculture—1963 data as well as projections to 1980, 2000, and 2020 were provided in a special report of the Economic Research Service, U.S. Department of Agriculture. In addition to projecting the output for the overall region, they also made projections for the three subregions. Their preliminary report, entitled, **Projected Agricultural Economy of the Puget Sound and Adjacent Waters Region, Washington, Giles Burgess, Jr., February 1967,** provided the source of these data.

It should be noted that in the case of some industries, it was necessary to adjust the output distribution reported in the ERS study. If this were not done, more sales would have been reported than could have been supported by the level of output.

Industry 5, Fishing—Projections to 1980 were based on data supplied by Dr. James Crutchfield. His estimates were based on biological and economic potentials. Using his estimates were based on biological and economic potentials. Using his estimates, we projected about a 25 percent increase in the 1963 value in the catch of bottom fish. Since this accounts for about 25 percent of the market, the increase in output is estimated at 6 percent.

Industries 15–19, 21–23, Forest Products—Output projections for these industries were based partially on a report entitled, **Prospective Timber Supplies and Forest Industrial Development in the Puget Sound Basin and Adjacent Waters,** by Brian Wall, U.S. Department of Agriculture, Forest Service. These projections, which included projections to 2000 and 2020, formed the basis for the output estimates in these industries.

The projections were made in terms of physical output. However, they were converted to dollar output in 1963 prices. Employment projections were not taken from this study. Rather, to ensure consistency with the other data, they were based on national trends, as was the case in other industries.

Industry 27, Petroleum Refining—Estimates for petroleum output in 1980 were taken from **The Potential for the Petroleum Industry in the Pacific Northwest,** U.S. Department of the Interior, Bonne-

ville Power Administration, 1966. These projections, which did not extend out to 2000 and 2020, were based upon a detailed study of petroleum refining and oil discovery potential for the whole Pacific Northwest. Although dollar output projections were not given, it was a relatively simple matter to convert physical output to dollar units.

Industry 32, Aluminum—Data for the projection of the aluminum industry output were derived from **The Aluminum Industry of the Pacific Northwest,** U.S. Department of the Interior, Bonneville Power Administration, 1966. In addition to utilizing this report, discussions with industry experts were also taken into account. In view of the recent discussion concerning the possibility of an aluminum plant at Guemes Island, it should be noted that this report assumed that increased growth in the North region will take place. Whether this will come from additional plants or the expansion of existing capacity is not relevant for the projections. The contention of the industry expert is that the region has a good potential and this report followed that concensus.

Industry 39, Aerospace—The projections of the aerospace industry, as noted in the text, relied upon correspondence and discussions with industry officials. These discussions led to a range of possibilities, rather than a projection. In addition, there was no consideration of the years 2000 and 2020. Two facts already noted in the text bear repeating here: (1) The industry under discussion includes more than The Boeing Company; and (2) Projected employment figures were not taken from these sources of information.

SPECIFIC CITATIONS

Listed below are the specific sources utilized in conjunction with the tables and charts presented in the general text. Where no reference is given, the data were developed by this study.

Table or Chart	Source
Table I-1	Washington State Department of Employment Security provided estimates of total employment for the Seattle-Everett and Tacoma SMSA's. Estimates of total employment were derived from covered employment data on the remaining counties by this study. Agricultural employment data were developed in the Economic Research Service study cited above.
Table I-2	Population taken from, **Population Forecasts, State of Washington: 1965 to 1985,** Washington State Census Board and Washington State Department of Commerce and Economic Development, Olympia, 1966.
Table I-3	Same as Table I-2 for PS&AW. U.S. Population taken from: U.S. Department of Commerce, **Long Term Economic Growth: 1860 to 1965,** October 1966.
Figure I-2	Same as Table I-3.
Figure I-3	PS&AW Personal Income taken from preliminary report on Columbia-North Pacific River Basin and Subregions, prepared by Office of Business Economics, U.S. Department of Commerce. U.S. Personal Income, see **Long Term Economic . . . op.cit.**
Figure I-4	Washington employment from Covered Employment Series, Washington State Department of Employment Security. U.S. employment from **Employment and Wages,** U.S. Bureau of Employment Security.
Figure I-5	Same as Table I-2.
Figure I-6	Value Added is taken from various **U.S. Census of Manufactures.**

Table I-5	U.S. growth rates from Almon, cited above in General Sources.
Figure III-1	Same as Tables I-1 and I-2.
Table III-1	PS&AW employment, same as Table I-1. U.S. employment **U.S. Census of Manufacturing,** 1963, pp.69-71. General Summary (MC 63(1)-1).
Table III-6	Same as Table I-1.
Table IV-2	See sources by industry in General Source discussion above.

SELECT BIBLIOGRAPHY

A good general introduction to input-output analysis is given in, Miernyk, William, **The Elements of Input-Output Analysis,** (New York: Random House, 1965).

More technical discussions are found in: Chenery, Hollis B., and Clark, Paul G., **Interindustry Economics,** (New York: John Wiley & Sons, Inc., 1959); Evans, W. Duane and Hoffenberg, Marvin, "The Interindustry Relations Study for 1947", **The Review of Economics and Statistics,** XXXIV (May 1952), 97-142; Leontief, Wassily, et al, **Studies in the Structure of the American Economy,** (New York: Oxford University Press, 1953); and Goldman, Morris R., Marimont, Martin L. and Vaccava, Beatrice N., "The Interindustry Structure of the United States: A Report on the 1958 Input-Output Study", **Survey of Current Business,** U.S. Department of Commerce, November 1964, (also see subsequent issues for further details).

Regional aspects of input-output analysis are discussed in Isard, Walter, "International and Regional Input-Output Analysis: A Model of a Space Economy", **The Review of Economics and Statistics,** XXXII, (Nov. 1951), 318-28; Tiebout, Charles M., "Regional and Interregional Input-Output Models: An Appraisal", **Southern Economic Journal** XXIV (Nov. 1957), 140-47.

Additional citations are to be found in United Nations, **Input–Output Bibliography, 1960-1963,** Series M, No. 39, New York; 1964.

TECHNICAL APPENDIX

THE INPUT—OUTPUT MODEL: 1963

The particular model used in this study is an open, static Leontief input-output model. The basic 1963 Puget Sound table consists of 56 interindustry sectors plus six final demand sectors. The final demand sectors consist of local consumption, local investment, and state and local government expenditures—including Federal endogenous expenditures such as the Post Office—plus three outside sectors: exports to foreign nations, sales to the Federal government of non-endogenous items, and exports to other regions in the United States. (The latter sector—exports to the rest of the United States—was broken into two regions. One region is the California—Oregon region; the other consists of the rest of the United States less California and Oregon.) In terms of input-output rows, the basic 1963 matrix consisted of two additional rows: a value added row and an import row.

The 1980 Puget Sound Model

This model begins by identifying 59 interindustry sectors plus four final demand sectors such that:

$$(1) \quad {}_rX_i = \sum_{j=1}^{59} r_{ij}\, {}_rX_j + FD_i \qquad i=1,..59$$

Here, ${}_rX_i$ represents the total output (X) of industry $\underline{i}$ in the region, $\underline{r}$. The term $r_{ij} = \frac{{}_rx_{ij}}{{}_rX_j}$, where ${}_rx_{ij}$ is the dollars of output of regional industry $\underline{i}$ sold to regional industry $\underline{j}$. FD_i represents the shipments to final demand sectors.

Sectors 1,. . . 56 represent the normal I-0 industrial groupings. Column 57 represents the disaggregated average propensity to consume out of personal regional income. Column 58 represents the disaggregated marginal propensities to consume out of personal regional income column. Column 59 is composed of disaggregated average propensities of both private investment and state and local government spending. Row 57 corresponds to the extensive personal income component of value added (defined below). Row 58 represents the intensive income component of value added (defined below). Row 59 consists of non-personal income component of value added. The rationale for these entries is presented below.

The four final demands (Y_{ip}'s) are: Federal purchases, world trade, exports to California—Oregon, and exports to the rest of the United States (less California and Oregon). Thus,

$$(2) \quad FD_i = \sum_{p=1}^{4} Y_{ip} \qquad i = 1, . . . 59$$

Given a matrix, A, of direct regional coefficients (r_{ij}'s), the usual $(I-A)^{-1}$ matrix can be developed. Although it was not carried in quite this manner:

$$(3) \quad {}_rX^{80}_i = (I-A)^{-1}\ FD^{80}_i \qquad i = 1, . . .59$$

would yield the total projected output for each industry in 1980.

Eleven industries had their output projected independently. For these industries,

$$(4) \quad {}_rFD^{80}_m = {}_rX^{80}_m - \sum_{j=1}^{59} r_{mj}\ X^{80}_j \qquad m = 1, . . .11$$

As can be seen in (4), final demand (exports) for these industries are a residual after local demands. For these industries, the exports were not disaggregated into the four sectors noted above. Only Federal demands and an aggregate export figure are shown in Table V-3.

Given that 11 sectors had their total output projected, the remaining 48 sectors were projected by,

$$(5) \quad {}_rX^{80}_h = (I-A)^{-1}\left[FD^{80}_h + \sum_{m=1}^{11} r_{hm}\ {}_rX^{80}_m\right]$$

$$h = 1,. . .48$$

If only the first term within the right hand bracket were included, (5) would represent the solution of a 48-sector projection model. The right hand term merely adds to the final demands the outputs from the 48 sectors needed as inputs by the 11 output projected industries.

With respect to the direct coefficients, by definition,

$$(6) \quad a_{ij} = r_{ij} + m_{ij} \qquad i, j = 1,. . .59$$

This specifies the total technical coefficient, a_{ij} as the sum of the regional inputs r_{ij}, plus imported input

m_{ij}. (since j is a regional industry, there is no presumption that a_{ij} is equal to the United States direct coefficient.)

The 1963 exports to California–Oregon and to the rest of the United States less these states were broken down into 59 receiving sectors: 56 industry groups, consumption, investment, and state and local governments. Given the output of any industry in one of these regions in 1963,

$$(7)\quad {}_{rc}t_{hk} = \frac{{}_{rc}x_{hk}}{{}_{c}X_{k}} \quad k = 1,\ldots 59 \quad h = 1,\ldots 48 \quad c = 1,2$$

where ${}_{rc}x_{hk}$ represents the output of regional (r) industry $\underline{h}$ sold to industry $\underline{k}$ in region $\underline{c}$. ${}_{c}X_{k}$ is the total output of $\underline{k}$ in region $\underline{c}$. Thus, ${}_{rc}t_{hk}$ is a trade coefficient showing the amount of the regional industries output needed as inputs per dollar of the external region's industry output. Hence, in projecting,

$$(8)\quad {}_{rc}\overset{80}{x}_{hk} = \sum_{k=1}^{59} {}_{rc}t_{hk}\ {}_{c}\overset{80}{X}_{k} \quad c = 1,2 \quad h = 1,\ldots 48$$

Since ${}_{rc}\overset{80}{x}_{hk}$ only accounts for the California–Oregon and the rest of the U.S. export sectors, it is also necessary to account for the Federal and world trade sectors. For the Federal sector

$$(9)\quad {}_{r}t_{hF} = \frac{{}_{r}x_{hF}}{X_{hF}}$$

For 1963, the share of the Federal purchase of $\underline{h}$ from the region divided by total Federal purchases of $\underline{k}$, (X_{hF}), yields a trade coefficient ${}_{r}t_{hF}$. For 1980,

$$(10)\quad {}_{r}\overset{80}{x}_{hF} = {}_{r}t_{hF}\ \overset{80}{X}_{hF}$$

World trade was projected in a somewhat different manner, as described below. For completeness, however, we note

$$(11)\quad {}_{r}\overset{80}{x}_{hw} = \text{autonomous}$$

Given, (8), (10), and (11),

$$(12)\quad FD_{h}^{80} = {}_{rc}\overset{80}{x}_{hk} + {}_{r}\overset{80}{x}_{hF} + {}_{r}\overset{80}{x}_{hW} \quad c = 1,2$$
$$h = 1,\ldots 48 \quad k = 1,\ldots 59$$

Inserting (12) into (5) above solves for the total output of the 48 sectors not projected separately.

The determinants of induced consumption, investment, and state and local government spending, as well as employment, are closely related. The simple way to estimate employment, given output projections, would be through an employment coefficient showing the employment per dollar of output. This could be adjusted over the 17-year projection period, on the basis of national industry data provided by Almon, to allow for productivity increases. While the results would be the same, this was not done. Instead, we worked through the value added coefficient.

Value added, or gross regional product, was used as the independent variable generating consumption, investment, and state and local government expenditures. For the projection year 1980, the value added consisted of three components:

$$(13)\quad V_i = V_i^{i} + V_i^{e} + V_i^{n}$$

The last term V_i^n represents non-personal income value added. As such, it consists of depreciation, indirect taxes, corporate taxes, savings, and the like. In turn, the sum $V_i^i + V_i^e$ adds up to something akin to personal income originating in the region.

In 1980, personal income originating in the region consists of two components: V_i^i represents the dollar value of the 1980 personal income which represents increased per capita income since 1963, and V_i^e represents the 1963 income plus added income resulting from extensive growth. Extensive growth is defined as more output and employment without any increase in per capita income.

Since this concept is new, it may be desirable to labor the point by way of a couple of examples. Suppose regional personal income in 1963 were \$100. In 1980 assume income is projected to be \$200. Yet, suppose all of this increase results in no change in employment, thanks to increased productivity. In this case, half of the \$200 would be V_i^i and the original \$100 would be V_i^e. If, at the other extreme, associated with a projected doubling of value added was a doubling of employment, it implies that all growth is extensive; i.e., V_i^e = \$200.

This division is important, since 1980 income classed as V_i^i, intensive, is assigned to the disaggregated marginal propensity to consume column. Extensive income, V_i^e, is assigned to the disaggregated average propensity to consume column. The presumption should be clear; as new residents move in to fill jobs at the same wage rate as established residents, average consumption propensities are relevant. Inso-

far as regional income rises because of increased per capita incomes, marginal consumption propensities apply.

In terms of the model's mechanics, projected value added in any industry is determined by:

$$(14)\quad V_i^{80} = v_i^i X_i^{80} + v_i^e X_i^{80} + v_i^n X_i^{80}$$

Here, $v_i^i + v_i^e + v_i^n = \frac{V_i}{X_i}$

That is, the sum of the three components of value added are a constant share of output. (This assumption, it should be noted, was forced by the lack of data. In a few industries some adjustments were made).

In order to see how the generation of the value added component works, a simple illustration may help. Suppose

$$1963 \quad \frac{V_i}{X_i} = .5. \quad \text{Let } v_i^n = .1,$$

leaving .4 to be divided between v_i^i and v_i^e. Assume that productivity is projected to increase 100 percent over the 17-year interval. Now, ask the question, how many employees are needed to produce the same output as in 1963? With productivity doubling, half the 1963 number will suffice. Thus, setting the 1963 productivity at 1.0, the new productivity is 2.0, and

$$v_i^e = \frac{1.0}{2.0} \times .4 = .20$$

The residual .4 – .20 represents v_i^i.

All this helps to explain the rationale for the three components of value added rows. Put somewhat more verbally, imagine a 59 x 59 interindustry direct coefficients matrix with the first 56 entries, the usual interindustry direct coefficients. Row 57 represents the extensive value added coefficients, v_i^e, and column 57 represents the disaggregated average propensity to consume column. Row 58 represents the intensive value added coefficients, v_i^i, and column 58 represents the disaggregated marginal propensity to consume column. Row 59 represents the nonpersonal income component, v_i^n, and column 59 the disaggregated investment and state and local government expenditure column. Naturally, it is the row sum of each of these rows that is addressed to the column coefficients. Given this discussion, it is possible to see how employment estimates were generated by:

$$(15)\quad E_i^{80} = \frac{v_i^e X_i^{80}}{v_i^i X_i^{63} + v_i^e X_i^{63}} \cdot E_i^{63}$$

As (15) notes, if extensive growth to 1980 just kept pace with productivity increases, no change in employment would occur. Insofar as extensive growth outstrips productivity, employment will increase.

TABLE A-1
DIRECT REQUIREMENTS: PS&AW, 1963

(Each entry shows the dollars worth of inputs needed from the PS&AW industry named at the left, per dollar of output of the industry named at the top)

TABLE A-1
DIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS
1963 DIRECT INPUT COEFFICIENTS

		1 FIELD CROP	2 VEGETABLES	3 LVSTK$PROD	4 OTHER AGRI	5 FISHING	6 MEAT PRODS	7 DAIRY PROD	8 CANN$PRES	9 GRAIN MLLS	10 BEVERAGES
1	FIELD CROP	0.031250	-0.000000	0.015353	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.009238	-0.000000
2	VEGETABLES	-0.000000	0.020725	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.131667	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	0.041965	-0.000000	-0.000000	0.168116	0.432618	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	0.020725	-0.000000	0.045455	-0.000000	-0.000000	-0.000000	0.008333	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	0.116667	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	0.039130	-0.000000	0.003333	0.016166	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	0.000725	0.142489	0.000833	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	0.009167	0.003464	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	0.310133	-0.000000	0.006410	0.027536	-0.000000	0.005000	0.033487	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	0.000858	-0.000000	-0.000000	0.056918
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	0.012821	0.002899	0.008584	0.021667	0.009238	0.009632
12	TEXTILES	-0.000000	0.005181	-0.000000	-0.000000	0.012821	-0.000000	-0.000000	-0.000000	0.001155	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	-0.000000	0.013857	-0.000000
14	MINING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	-0.000000	-0.000000	0.010235	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
19	OTHER WOOD	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	0.000858	-0.000000	-0.000000	0.002627
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	-0.000000	-0.000000	-0.000000	0.084416	-0.000000	-0.000000	-0.000000	-0.000000	0.001155	-0.000000
23	PAPBD MILS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.007971	0.014592	0.027500	0.018476	0.038529
24	PRINT$PUBS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000833	-0.000000	0.009632
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
26	OTHER CHEM	-0.000000	0.010363	0.004094	0.006494	-0.000000	-0.000000	-0.000000	0.000833	0.001155	0.001751
27	PET REFINE	0.062500	0.036269	0.014330	0.038961	0.044872	-0.000000	0.004292	0.001667	0.001155	0.003503
28	GLASS$STONE	-0.000000	-0.000000	-0.000000	0.006494	-0.000000	-0.000000	0.004292	0.005833	-0.000000	0.039405
29	CEM$CLAY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
30	IRON$STEEL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
31	NONFER MET	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
33	HEAVY METL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000858	-0.000000	-0.000000	0.001751
34	LITE METL	-0.000000	-0.000000	0.002047	-0.000000	-0.000000	0.006522	-0.000000	0.072500	-0.000000	0.084063
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
36	MACH TOOL	0.031250	0.031088	0.013306	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
37	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001667	-0.000000	0.000876
38	ELEC MACH	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	0.025641	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
43	TRANSPORT	-0.000000	-0.000000	0.011259	0.006494	0.012821	0.023188	0.031760	0.035000	0.016166	0.034151
44	ELEC COMPY	-0.000000	-0.000000	0.012282	0.012987	-0.000000	0.001449	0.002575	0.003333	0.003464	0.002627
45	GAS COMPY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002899	0.003433	0.003333	0.003464	0.001751
46	WATER SERV	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000725	0.000858	0.001667	-0.000000	0.001751
47	COMMUNICAT	-0.000000	-0.000000	0.004094	0.006494	0.006410	0.003623	0.002575	0.002500	0.001155	0.010508
48	P,U $ MISC	0.031250	0.005181	0.011259	0.006494	-0.000000	0.003623	0.003433	0.003333	0.004619	0.007005
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	-0.000000	-0.000000	0.014330	0.006494	0.032051	0.025362	0.036052	0.040000	0.016166	0.035902
52	FINANCE	0.062500	0.036269	0.081883	0.032468	0.006410	0.003623	0.002575	0.008333	0.005774	0.005254
53	INSURANCE	0.031250	0.020725	0.009212	0.019481	0.012821	0.003623	0.004292	0.009167	0.006928	0.007881
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
55	BUSI SERV	-0.000000	-0.000000	-0.000000	0.019481	0.038462	0.010870	0.016309	0.013333	0.016166	0.015762
56	PERS SERV	-0.000000	-0.000000	0.014330	0.012987	-0.000000	0.002899	0.005150	0.004167	0.003464	0.004378

TABLE A-1
DIRECT REQUIREMENTS 1963,
PUGET SOUND AND ADJACENT WATERS
1963 DIRECT INPUT COEFFICIENTS

		11 OTHR FOODS	12 TEXTILES	13 APPAREL	14 MINING	15 FORESTRY	16 LOGGING	17 SAWMILLS	18 PLYWOOD	19 OTHER WOOD	20 FURN$FIX
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	0.006494	-0.000000	-0.000000	-0.000000	0.011182	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	0.007305	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	0.004058	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	0.099026	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	0.004058	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	0.041396	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	-0.000000	-0.000000	0.004329	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003279
13	APPAREL	-0.000000	-0.000000	0.056277	-0.000000	-0.000000	0.001040	-0.000000	-0.000000	-0.000000	-0.000000
14	MINING	0.001623	-0.000000	-0.000000	0.005291	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	0.018797	0.191268	0.033546	0.015020	0.006088	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.081081	0.217252	0.120158	0.082192	-0.000000
17	SAWMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.029553	0.013439	0.074581	0.055738
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.052174	0.027397	0.029508
19	OTHER WOOD	0.000812	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.016743	0.013115
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.013115
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	0.002435	-0.000000	0.002165	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
23	PAPBD MILS	0.031656	-0.000000	0.004329	-0.000000	-0.000000	-0.000000	-0.000000	0.000791	0.001522	0.016393
24	PRINT$PUBS	0.015422	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001597	0.000791	0.001522	-0.000000
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001522	-0.000000
26	OTHER CHEM	0.001623	-0.000000	0.002165	-0.000000	-0.000000	-0.000000	0.000799	0.054545	0.001522	0.022951
27	PET REFINE	0.005682	-0.000000	-0.000000	0.037037	-0.000000	0.005198	0.007188	-0.000000	0.010654	0.003279
28	GLASS$STONE	0.004870	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003044	-0.000000
29	CEM$CLAY	-0.000000	-0.000000	-0.000000	0.026455	-0.000000	-0.000000	-0.000000	0.000791	0.001522	-0.000000
30	IRON$STEEL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.006557
31	NONFER MET	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
33	HEAVY METL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001522	-0.000000
34	LITE METL	0.000812	-0.000000	0.002165	-0.000000	-0.000000	0.001040	0.001597	-0.000000	0.003044	-0.000000
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002079	-0.000000	0.000791	-0.000000	-0.000000
36	MACH TOOL	-0.000000	-0.000000	-0.000000	0.010582	-0.000000	0.001040	0.000799	0.000791	0.001522	-0.000000
37	NONELC EQP	0.000812	-0.000000	-0.000000	0.010582	-0.000000	0.002079	0.001597	0.002372	-0.000000	-0.000000
38	ELEC MACH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001040	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003279
43	TRANSPORT	0.034091	-0.000000	0.002165	0.021164	-0.000000	0.070686	0.067093	0.030040	0.022831	0.036066
44	ELEC COMPY	0.001623	-0.000000	0.002165	0.005291	-0.000000	-0.000000	0.007987	0.004743	0.003044	0.003279
45	GAS COMPY	0.004058	-0.000000	-0.000000	0.005291	-0.000000	-0.000000	0.000799	0.000791	0.001522	0.003279
46	WATER SERV	0.001623	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000791	-0.000000	-0.000000
47	COMMUNICAT	0.005682	-0.000000	0.004329	-0.000000	0.003759	0.004158	0.003195	0.003953	0.001522	0.006557
48	P,O $ MISC	0.001623	-0.000000	0.002165	-0.000000	-0.000000	0.001040	-0.000000	0.000791	0.001522	-0.000000
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.034903	-0.000000	0.008658	0.031746	-0.000000	0.033264	0.047923	0.029249	0.036530	0.042623
52	FINANCE	0.004870	-0.000000	0.004329	0.005291	0.007519	0.002079	0.002396	0.003162	0.001522	0.003279
53	INSURANCE	0.007305	-0.000000	0.008658	0.010582	0.011278	0.004158	0.007987	0.007905	0.009132	0.009836
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
55	BUSI SERV	0.017857	-0.000000	0.008658	0.010582	0.003759	0.003119	0.011981	0.010277	0.010654	0.003279
56	PERS SERV	0.004058	-0.000000	0.004329	0.005291	-0.000000	0.004158	0.004792	0.005534	0.006088	0.006557

TABLE A-1
DIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS
1963 DIRECT INPUT COEFFICIENTS

		21	22	23	24	25	26	27	28	29	30
		PULPMILLS	PAPER MLLS	PAPBD MILS	PRINT$PUBS	INDUS$CHEM	OTHER CHEM	PET REFINE	GLASS$STONE	CEM$CLAY	IRON$STEEL
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.012245	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	-0.000000	-0.000000	0.000812	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
14	MINING	-0.000000	0.001200	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.012048	0.098945	0.001642
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	0.188552	0.047419	0.021104	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	0.028620	0.011405	0.004058	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001319	-0.000000
18	PLYWOOD	0.005051	0.006002	0.002435	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
19	OTHER WOOD	0.001684	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000391	-0.000000	-0.000000	0.001642
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
21	PULPMILLS	0.015152	0.031313	0.133929	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	0.001684	0.000600	0.021104	0.061772	-0.000000	0.002041	0.000391	0.006024	0.001319	-0.000000
23	PAPBD MILS	-0.000000	0.012605	0.051136	0.001166	-0.000000	0.012245	0.000391	0.066265	0.021108	-0.000000
24	PRINT$PUBS	-0.000000	0.000600	0.000812	0.022145	-0.000000	0.004082	0.000391	0.018072	0.001319	-0.000000
25	INDUS$CHEM	0.008418	0.001200	0.000812	-0.000000	-0.000000	0.008163	0.000782	-0.000000	-0.000000	-0.000000
26	OTHER CHEM	0.006734	0.007203	0.005682	0.023310	0.014019	0.026531	-0.000000	0.024096	0.001319	0.001642
27	PET REFINE	0.016835	0.014406	0.015422	-0.000000	0.009346	0.008163	0.007816	-0.000000	0.052770	-0.000000
28	GLASS$STONE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002041	-0.000000	-0.000000	-0.000000	0.014778
29	CEM$CLAY	0.016835	0.000600	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.006024	0.166227	0.009852
30	IRON$STEEL	0.001684	0.000600	0.000812	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.006596	0.019704
31	NONFER MET	0.001684	-0.000000	-0.000000	-0.000000	-0.000000	0.006122	-0.000000	-0.000000	0.001319	0.003[illegible]84
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
33	HEAVY METL	0.001684	0.000600	-0.000000	-0.000000	-0.000000	-0.000000	0.000391	-0.000000	0.003958	-0.000000
34	LITE METL	0.003367	0.000600	0.000812	0.002331	-0.000000	0.002041	0.004689	-0.000000	0.005277	0.001642
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001319	-0.000000
36	MACH TOOL	0.001684	-0.000000	-0.000000	-0.000000	-0.000000	0.004082	-0.000000	-0.000000	0.006596	0.001642
37	NONELC EQP	0.005051	0.003601	0.001623	-0.000000	0.004673	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
38	ELEC MACH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001172	-0.000000	0.002639	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000391	-0.000000	0.002639	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000391	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	0.001684	-0.000000	0.000812	0.001166	-0.000000	0.004082	-0.000000	-0.000000	-0.000000	-0.000000
43	TRANSPORT	0.033670	0.020408	0.020292	0.006993	0.014019	0.008163	0.023056	0.018072	0.060686	0.016420
44	ELEC COMPY	0.006734	0.012605	0.008117	0.003497	0.037383	0.002041	0.004299	0.012048	0.006596	0.016420
45	GAS COMPY	0.008418	0.014406	0.007305	0.001166	-0.000000	-0.000000	0.000391	0.012048	0.003958	0.008210
46	WATER SERV	0.003367	0.000600	-0.000000	-0.000000	-0.000000	-0.000000	0.000391	-0.000000	-0.000000	-0.000000
47	COMMUNICAT	0.001684	0.002401	0.001623	0.009324	0.004673	0.002041	0.001172	0.006024	0.003958	0.004926
48	P.U $ MISC	0.005051	0.002401	0.001623	0.003497	-0.000000	-0.000000	0.003908	-0.000000	-0.000000	0.006568
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.038721	0.024610	0.025974	0.011655	0.009346	0.012245	0.001172	0.018072	0.030343	0.068966
52	FINANCE	0.005051	0.006603	0.006494	0.005828	0.004673	0.006122	0.002735	0.006024	0.009235	0.006568
53	INSURANCE	0.010101	0.009004	0.008929	0.009324	0.004673	0.008163	0.005862	0.012048	0.009235	0.008210
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001642
55	BUSI SERV	0.005051	0.003601	0.004058	0.010490	-0.000000	0.006122	0.005080	0.012048	0.003958	0.011494
56	PERS SERV	0.005051	0.004802	0.004058	0.037296	0.004673	0.008163	0.011723	0.012048	0.005277	0.004926

TABLE A-1
DIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS

1963 DIRECT INPUT COEFFICIENTS

		31	32	33	34	35	36	37	38	39	40
		NONFER MET	ALUMINUM	HEAVY METL	LITE METL	NONELC EQP	MACH TOOL	NONELC EQP	ELEC MACH	AEROSPACE	MOTOR VEH
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
14	MINING	0.010121	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000083	0.001222
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000249	0.002445
19	OTHER WOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002160	-0.000000	0.000083	-0.000000
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000083	0.001222
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	-0.000000	-0.000000	0.001515	-0.000000	-0.000000	-0.000000	-0.000000	0.002336	0.000166	-0.000000
23	PAPBD MILS	-0.000000	-0.000000	-0.000000	0.007353	-0.000000	-0.000000	0.002160	0.004673	0.000332	0.001222
24	PRINT$PUBS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002160	-0.000000	0.002155	-0.000000
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000083	-0.000000
26	OTHER CHEM	-0.000000	-0.000000	0.012121	0.003676	-0.000000	-0.000000	-0.000000	-0.000000	0.000414	0.002445
27	PET REFINE	0.014170	-0.000000	0.003030	0.001838	0.002128	-0.000000	-0.000000	-0.000000	0.000746	0.001222
28	GLASS$STONE	-0.000000	-0.000000	0.001515	0.001838	0.002128	0.003984	-0.000000	-0.000000	0.000166	0.001222
29	CEM$CLAY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000166	-0.000000
30	IRON$STEEL	-0.000000	-0.000000	0.162121	0.014706	0.055319	0.023904	0.004320	0.004673	0.000166	0.061125
31	NONFER MET	0.232794	-0.000000	-0.000000	-0.000000	0.006383	0.007968	-0.000000	0.011682	0.000249	0.002445
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000083	0.001222
33	HEAVY METL	-0.000000	-0.000000	0.006061	0.005515	0.004255	-0.000000	-0.000000	-0.000000	-0.000000	0.012225
34	LITE METL	-0.000000	-0.000000	0.001515	0.044118	0.012766	0.003984	0.004320	-0.000000	0.000829	0.012225
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	0.006383	-0.000000	0.004320	-0.000000	-0.000000	-0.000000
36	MACH TOOL	-0.000000	-0.000000	0.003030	0.003676	0.027660	0.019920	0.002160	0.002336	0.005802	-0.000000
37	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	0.010638	0.007968	0.015119	-0.000000	0.000083	-0.000000
38	ELEC MACH	-0.000000	-0.000000	0.003030	-0.000000	0.004255	0.003984	0.004320	0.004673	0.002818	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.012433	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.006112
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002160	-0.000000	0.001575	0.001222
43	TRANSPORT	-0.000000	0.011765	0.004545	0.005515	0.004255	-0.000000	0.002160	0.002336	0.001077	0.003667
44	ELEC COMPY	0.008097	0.047059	0.007576	0.007353	0.004255	0.007963	0.004320	0.004673	0.001823	0.001222
45	GAS COMPY	0.014170	-0.000000	-0.000000	0.003676	-0.000000	-0.000000	0.002160	0.002336	0.000580	-0.000000
46	WATER SERV	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000166	-0.000000
47	COMMUNICAT	0.002024	-0.000000	0.003030	0.003676	0.002128	0.003984	0.002160	0.004673	0.005139	0.002445
48	P,U $ MISC	-0.000000	-0.000000	-0.000000	-0.000000	0.002128	0.003984	0.002160	-0.000000	0.001741	0.003667
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.012146	0.011765	0.018182	0.007353	0.019149	0.019920	0.017279	0.014019	0.002238	0.004890
52	FINANCE	0.002024	-0.000000	0.006061	0.007353	0.002128	0.003984	0.004320	0.002336	0.000829	0.003667
53	INSURANCE	0.006073	0.011765	0.009091	0.009191	0.008511	0.007968	0.010799	0.007009	0.002155	0.007335
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002336	-0.000000	-0.000000
55	BUSI SERV	0.004049	-0.000000	0.007576	0.007353	0.002128	0.003984	0.010799	0.007009	0.004144	0.014670
56	PERS SERV	0.004049	-0.000000	0.003030	0.005515	0.004255	0.003984	0.004320	0.004673	0.000829	0.002445

TABLE A-1
DIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS

1963 DIRECT INPUT COEFFICIENTS

		41 SHIP BLDG	42 OTHER MFGS	43 TRANSPORT	44 ELEC COMPY	45 GAS COMPY	46 WATER SERV	47 COMMUNICAT	48 P,O $ MISC	49 HOUSING	50 HIGHWAYS
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	0.000992	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	-0.000000	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
13	APPAREL	0.000464	0.006098	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	0.001243	0.001018	-0.000000
14	MINING	-0.000000	-0.000000	0.000662	-0.000000	-0.000000	-0.000000	-0.000000	0.002797	0.002374	0.061189
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	0.000929	0.003049	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.015848	0.042402	0.003497
18	PLYWOOD	0.001858	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003108	0.008141	0.001748
19	OTHER WOOD	0.000929	0.003049	0.004300	-0.000000	-0.000000	-0.000000	-0.000000	0.009323	0.024763	0.001748
20	FURN$FIX	0.000464	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001865	0.001696	-0.000000
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	0.000464	0.003049	-0.000000	0.000816	-0.000000	-0.000000	0.001988	-0.000000	-0.000000	-0.000000
23	PAPBD MILS	0.000929	0.003049	0.000992	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
24	PRINT$PUBS	0.000929	-0.000000	0.001323	0.002449	0.003891	-0.000000	0.002651	0.000932	0.000678	-0.000000
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.007042	-0.000000	-0.000000	-0.000000	-0.000000
26	OTHER CHEM	0.003716	0.003049	0.003639	-0.000000	-0.000000	-0.000000	-0.000000	0.004661	0.008820	0.001748
27	PET REFINE	0.000464	-0.000000	0.075422	0.005714	-0.000000	-0.000000	0.003313	0.012430	0.010176	0.038462
28	GLASS$STONE	0.000464	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001865	0.001357	0.001748
29	CEM$CLAY	0.001858	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	0.000663	0.074580	0.053596	0.062937
30	IRON$STEEL	0.018579	-0.000000	0.001323	0.000816	-0.000000	-0.000000	-0.000000	0.013052	0.013229	0.010490
31	NONFER MET	0.001393	-0.000000	-0.000000	0.000816	-0.000000	-0.000000	-0.000000	0.001554	0.001018	0.001748
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000339	-0.000000
33	HEAVY METL	0.002322	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000663	0.041019	0.020692	0.020979
34	LITE METL	0.004645	-0.000000	0.001985	0.001633	0.007782	-0.000000	-0.000000	0.006215	0.005767	-0.000000
35	NONELC EQP	0.002322	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
36	MACH TOOL	0.002322	0.003049	0.000662	-0.000000	-0.000000	-0.000000	-0.000000	0.003108	0.002374	0.003497
37	NONELC EQP	0.001393	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
38	ELEC MACH	0.005574	-0.000000	-0.000000	0.000816	-0.000000	-0.000000	0.002651	0.002175	0.001018	-0.000000
39	AEROSPACE	-0.000000	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	0.001393	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	0.002322	0.042683	0.000331	-0.000000	-0.000000	-0.000000	0.000663	0.000932	0.000339	-0.000000
43	TRANSPORT	0.004645	0.006098	0.004631	0.012245	-0.000000	-0.000000	0.000663	0.014916	0.013229	0.027972
44	ELEC COMPY	0.001858	0.009146	0.003639	0.145306	-0.000000	0.007042	0.005302	0.000622	0.000339	-0.000000
45	GAS COMPY	0.000464	0.003049	0.001323	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
46	WATER SERV	0.000464	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	0.000311	-0.000000	-0.000000
47	COMMUNICAT	0.001858	0.006098	0.009262	0.002449	0.003891	-0.000000	0.007952	0.004972	0.003392	0.003497
48	P,O $ MISC	0.000464	-0.000000	0.026795	0.024490	0.019455	0.021127	0.020543	0.001243	0.001018	0.001748
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.012076	0.009146	0.019186	0.009796	-0.000000	-0.000000	0.005302	0.057800	0.042741	0.029720
52	FINANCE	0.001858	0.006098	0.003308	0.002449	0.003891	0.007042	0.002651	0.004972	0.003392	0.003497
53	INSURANCE	0.006503	0.009146	0.011247	0.008980	0.007782	0.007042	0.009278	0.009012	0.006445	0.006993
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001325	-0.000000	-0.000000	-0.000000
55	BUSI SERV	0.013934	0.018293	0.011247	0.016327	0.011673	0.007042	0.009940	0.033872	0.013229	0.040210
56	PERS SERV	0.002322	0.006098	0.021171	0.004082	0.003891	0.007042	0.003976	0.004040	0.002374	0.003497

TABLE A-1
DIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS

1963 DIRECT INPUT COEFFICIENTS

		51 WHSLE$RET	52 FINANCE	53 INSURANCE	54 REA ESTATE	55 BUSI SERV	56 PERS SERV
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000585
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000585
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000974
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000974
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	0.000720	-0.000000	-0.000000	-0.000000	-0.000000	0.003313
12	TEXTILES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	0.000636	-0.000000
14	MINING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000195
19	OTHER WOOD	0.000560	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	0.001840	-0.000000	0.000452	-0.000000	0.000636	0.000390
23	PAPBD MILS	0.004719	0.000557	0.000452	-0.000000	-0.000000	0.000195
24	PRINT$PUBS	0.023434	0.021182	0.013104	0.048469	0.015267	0.009353
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
26	OTHER CHEM	-0.000000	-0.000000	-0.000000	0.001276	-0.000000	0.001169
27	PET REFINE	0.010557	0.002230	-0.000000	0.026786	0.001908	0.008574
28	GLAS$STONE	0.000160	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
29	CEM$CLAY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
30	IRON$STEEL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
31	NONFER MET	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
33	HEAVY METL	0.000320	-0.000000	-0.000000	-0.000000	0.001272	0.000390
34	LITE METL	0.000240	-0.000000	-0.000000	-0.000000	-0.000000	0.003702
35	NONELC EQP	0.000160	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
36	MACH TOOL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000779
37	NONELC EQP	0.000240	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
38	ELEC MACH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	0.000640	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	0.000320	0.000557	-0.000000	-0.000000	0.000636	0.000195
43	TRANSPORT	0.011597	0.008361	0.007682	0.007653	0.003817	0.006430
44	ELEC COMPY	0.014077	0.003902	0.000452	0.024235	0.001908	0.009548
45	GAS COMPY	0.001680	0.001115	0.001808	0.008929	0.001272	0.000585
46	WATER SERV	0.001040	0.000557	0.000904	0.007653	0.000636	0.002923
47	COMMUNICAT	0.023434	0.017837	0.008586	0.008929	0.017812	0.018706
48	P.O $ MISC	0.009118	0.008361	0.002259	0.080357	0.002545	0.020655
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.017036	0.010591	0.009489	0.020408	0.013359	0.047155
52	FINANCE	0.011117	0.053512	0.006326	0.008929	0.006361	0.007015
53	INSURANCE	0.007918	0.005574	0.055581	0.019133	0.008906	0.009158
54	REA ESTATE	0.012797	0.013935	0.011297	0.044643	0.010178	0.022798
55	BUSI SERV	0.014716	0.023369	0.022142	0.044643	0.058524	0.021824
56	PERS SERV	0.012877	0.010591	0.003163	0.010204	0.012087	0.033905

TABLE A–2. Direct and indirect requirements: PS&AW, 1963

(Each entry shows for the industry named at the left the dollars worth of output required directly and indirectly per dollar of delivery to final demand of the industry named at the top.)

TABLE A-2
DIRECT AND INDIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS
MATRIX INVERSE

		1	2	3	4	5	6	7	8	9	10
		FIELD CROP	VEGETABLES	LVSTK$PROD	OTHER AGRI	FISHING	MEAT PRODS	DAIRY PROD	CANN$PRES	GRAIN MLLS	BEVERAGES
1	FIELD CROP	1.032258	0.000001	0.019761	0.000001	0.000168	0.003754	0.009981	0.000116	0.009940	0.000012
2	VEGETABLES	0.000001	1.021165	0.000167	0.000005	0.000893	0.000052	0.000101	0.135829	0.000499	0.000017
3	LVSTK$PROD	0.000003	0.000026	1.044839	0.000030	0.004680	0.183320	0.527189	0.001747	0.003127	0.000073
4	OTHER AGRI	0.000007	0.022174	0.000182	1.047635	0.000133	0.000039	0.000098	0.011781	0.000151	0.000012
5	FISHING	0.000001	0.000001	0.000146	0.000004	1.007231	0.000045	0.000088	0.118621	0.000435	0.000015
6	MEAT PRODS	0.000009	0.000145	0.005755	0.000126	0.006933	1.042274	0.002976	0.004544	0.017511	0.000122
7	DAIRY PROD	0.000003	0.000002	0.000058	0.000017	0.007669	0.000933	1.166307	0.002104	0.000119	0.000114
8	CANN$PRES	0.000008	0.000005	0.001244	0.000037	0.006639	0.000386	0.000749	1.010230	0.003708	0.000126
9	GRAIN MLLS	0.000006	0.000016	0.335810	0.000042	0.009848	0.088957	0.170542	0.009248	1.037226	0.001151
10	BEVERAGES	0.000001	0.000001	0.000023	0.000005	0.006919	0.000029	0.001132	0.000929	0.000054	1.060414
11	OTHR FOODS	0.000012	0.000039	0.003372	0.000070	0.013913	0.004081	0.012234	0.024618	0.010174	0.010736
12	TEXTILES	0.000001	0.005291	0.000418	0.000002	0.012961	0.000118	0.000228	0.002265	0.001289	0.000041
13	APPAREL	0.000050	0.000012	0.004974	0.000041	0.007083	0.001341	0.002566	0.000992	0.015264	0.000065
14	MINING	0.000411	0.000091	0.000233	0.000329	0.000076	0.000135	0.000312	0.000254	0.000120	0.000734
15	FORESTRY	0.000066	0.000041	0.001007	0.001163	0.000248	0.000300	0.000771	0.000416	0.000268	0.000652
16	LOGGING	0.000214	0.000179	0.003151	0.005682	0.000916	0.001143	0.002822	0.001995	0.001296	0.003073
17	SAWMILLS	0.000594	0.000142	0.011398	0.001321	0.000674	0.002191	0.006124	0.000518	0.000356	0.000838
18	PLYWOOD	0.000126	0.000039	0.000099	0.000624	0.000263	0.000077	0.000179	0.000183	0.000110	0.000300
19	OTHER WOOD	0.000368	0.000089	0.000287	0.000172	0.006785	0.000241	0.001444	0.001104	0.000179	0.003167
20	FURN$FIX	0.000064	0.000012	0.000032	0.000018	0.000016	0.000016	0.000029	0.000015	0.000013	0.000020
21	PULPMILLS	0.000036	0.000104	0.001002	0.003133	0.000251	0.001513	0.003119	0.004406	0.002927	0.006539
22	PAPER MLLS	0.000220	0.002033	0.000926	0.088856	0.000462	0.000583	0.001199	0.002194	0.001885	0.002297
23	PAPBD MILS	0.000216	0.000282	0.007146	0.001934	0.001733	0.010991	0.022648	0.031875	0.021076	0.047542
24	PRINT$PUBS	0.002348	0.001459	0.003641	0.002440	0.002515	0.001981	0.004047	0.003951	0.001480	0.013562
25	INDUS$CHEM	0.000056	0.000125	0.000075	0.000237	0.000057	0.000044	0.000098	0.000123	0.000062	0.000158
26	OTHER CHEM	0.000283	0.011133	0.005191	0.008070	0.000424	0.001224	0.003177	0.003474	0.001627	0.004272
27	PET REFINE	0.066203	0.038784	0.019887	0.044315	0.047921	0.006302	0.019371	0.017620	0.004404	0.009090
28	GLAS$STONE	0.000224	0.000324	0.000152	0.006847	0.000471	0.000085	0.005212	0.006355	0.000101	0.042094
29	CEM$CLAY	0.003059	0.000595	0.001586	0.001034	0.000277	0.000817	0.001494	0.000828	0.000674	0.001437
30	IRON$STEEL	0.001540	0.000945	0.000836	0.000327	0.000663	0.000440	0.000828	0.001685	0.000227	0.002171
31	NONFER MET	0.000432	0.000449	0.000263	0.000116	0.000166	0.000070	0.000166	0.000137	0.000046	0.000095
32	ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
33	HEAVY METL	0.001448	0.000292	0.000777	0.000517	0.000278	0.000444	0.001732	0.000809	0.000327	0.002896
34	LITE METL	0.000738	0.000421	0.002897	0.000531	0.001674	0.007818	0.001887	0.077195	0.000675	0.093706
35	NONELC EQP	0.000007	0.000003	0.000014	0.000018	0.000069	0.000009	0.000019	0.000029	0.000008	0.000021
36	MACH TOOL	0.033064	0.032472	0.014971	0.000115	0.000244	0.002714	0.007634	0.004740	0.000438	0.000494
37	NONELC EQP	0.000276	0.000274	0.000181	0.000369	0.000088	0.000070	0.000167	0.001878	0.000085	0.001105
38	ELEC MACH	0.000305	0.000199	0.000167	0.000120	0.006722	0.000065	0.000135	0.000874	0.000040	0.000098
39	AEROSPACE	0.000006	0.000003	0.000036	0.000020	0.000029	0.000050	0.000084	0.000070	0.000032	0.000069
40	MOTOR VEH	0.000043	0.000022	0.000068	0.000054	0.000073	0.000077	0.000137	0.000114	0.000050	0.000109
41	SHIP BLDG	0.000031	0.000018	0.000047	0.000037	0.025910	0.000053	0.000093	0.003122	0.000045	0.000072
42	OTHER MFGS	0.000086	0.000085	0.000142	0.000112	0.006877	0.000080	0.000157	0.000932	0.000077	0.000161
43	TRANSPORT	0.003352	0.001990	0.021364	0.011894	0.017134	0.029766	0.050396	0.041765	0.019358	0.041264
44	ELEC COMPY	0.001299	0.001267	0.018307	0.018489	0.001725	0.006098	0.014352	0.006992	0.005291	0.006736
45	GAS COMPY	0.000251	0.000183	0.001582	0.001621	0.000491	0.003670	0.005297	0.004472	0.004042	0.003460
46	WATER SERV	0.000136	0.000081	0.000215	0.000224	0.000202	0.000883	0.001264	0.001903	0.000127	0.002034
47	COMMUNICAT	0.002280	0.001526	0.008412	0.009459	0.009255	0.006891	0.009726	0.006862	0.002946	0.014597
48	P,O $ MISC	0.033777	0.006403	0.017119	0.009279	0.001943	0.008470	0.015001	0.007075	0.006658	0.010244
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.004498	0.002461	0.026639	0.012860	0.037213	0.034127	0.059722	0.051182	0.020696	0.045540
52	FINANCE	0.069140	0.040548	0.095079	0.037684	0.008900	0.021747	0.052526	0.017974	0.008369	0.008690
53	INSURANCE	0.035917	0.023995	0.015864	0.024345	0.016119	0.008236	0.015252	0.018134	0.009549	0.012917
54	REA ESTATE	0.001606	0.000986	0.002538	0.001698	0.001395	0.001252	0.002511	0.001631	0.000860	0.001370
55	BUSI SERV	0.004721	0.002962	0.011565	0.025654	0.044797	0.016348	0.028761	0.024297	0.020194	0.022581
56	PERS SERV	0.002330	0.001776	0.019684	0.016819	0.002880	0.008203	0.018556	0.008173	0.005375	0.009020

TABLE A-2
DIRECT AND INDIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS
MATRIX INVERSE

		11 OTHR FOODS	12 TEXTILES	13 APPAREL	14 MINING	15 FORESTRY	16 LOGGING	17 SAWMILLS	18 PLYWOOD	19 OTHER WOOD	20 FURN$FIX
1	FIELD CROP	0.001104	-0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000003	0.000001	0.000002
2	VEGETABLES	0.000637	-0.000000	0.000001	0.000007	0.000000	0.000019	0.000021	0.000011	0.000010	0.000012
3	LVSTK$PROD	0.004372	-0.000000	0.000009	0.000013	0.000000	0.000032	0.000040	0.000154	0.000027	0.000080
4	OTHER AGRI	0.000073	-0.000000	0.007210	0.000002	0.000000	0.000011	0.012077	0.000175	0.000924	0.000703
5	FISHING	0.000356	-0.000000	0.000001	0.000006	0.000000	0.000016	0.000019	0.000010	0.000009	0.000010
6	MEAT PRODS	0.001932	-0.000000	0.000039	0.000034	0.000001	0.000092	0.000118	0.000811	0.000095	0.000388
7	DAIRY PROD	0.008930	-0.000000	0.000005	0.000016	0.000000	0.000036	0.000042	0.000025	0.000023	0.000026
8	CANN$PRES	0.004738	-0.000000	0.000011	0.000050	0.000001	0.000139	0.000159	0.000084	0.000076	0.000087
9	GRAIN MLLS	0.108528	-0.000000	0.000014	0.000028	0.000001	0.000054	0.000066	0.000105	0.000043	0.000071
10	BEVERAGES	0.004521	-0.000000	0.000001	0.000009	0.000000	0.000028	0.000032	0.000016	0.000014	0.000016
11	OTHR FOODS	1.044537	-0.000000	0.000027	0.000056	0.000001	0.000060	0.000087	0.000068	0.000074	0.000079
12	TEXTILES	0.000174	1.000000	0.004591	0.000001	0.000000	0.000006	0.000002	0.000003	0.000003	0.003338
13	APPAREL	0.001639	-0.000000	1.059647	0.000022	0.000004	0.001238	0.000319	0.000190	0.000156	0.000072
14	MINING	0.001886	-0.000000	0.000045	1.008549	0.000003	0.000108	0.000119	0.000181	0.000308	0.000103
15	FORESTRY	0.000518	-0.000000	0.000099	0.000027	1.019158	0.212158	0.082765	0.044256	0.031595	0.006633
16	LOGGING	0.002499	-0.000000	0.000479	0.000112	0.000005	1.088334	0.243813	0.141593	0.113589	0.020565
17	SAWMILLS	0.000596	-0.000000	0.000135	0.000104	0.000005	0.000110	1.030586	0.014714	0.078683	0.059921
18	PLYWOOD	0.000210	-0.000000	0.000049	0.000019	0.000001	0.000034	0.000043	1.055077	0.029432	0.032022
19	OTHER WOOD	0.001155	-0.000000	0.000050	0.000192	0.000003	0.000417	0.000477	0.000261	1.017275	0.013803
20	FURN$FIX	0.000010	-0.000000	0.000006	0.000004	0.000000	0.000010	0.000009	0.000007	0.000008	1.013294
21	PULPMILLS	0.005359	-0.000000	0.000782	0.000145	0.000004	0.000055	0.000118	0.000285	0.000334	0.002512
22	PAPER MLLS	0.004825	-0.000000	0.003116	0.000282	0.000046	0.000216	0.001460	0.000476	0.000524	0.000796
23	PAPBD MILS	0.038258	-0.000000	0.005008	0.001000	0.000015	0.000351	0.000521	0.001984	0.002329	0.018285
24	PRINT$PUBS	0.018718	-0.000000	0.000820	0.001700	0.000456	0.001563	0.004131	0.002878	0.003755	0.002250
25	INDUS$CHEM	0.000130	-0.000000	0.000036	0.000038	0.000000	0.000015	0.000030	0.000501	0.001598	0.000280
26	OTHER CHEM	0.003009	-0.000000	0.002533	0.000220	0.000015	0.000387	0.001430	0.059435	0.003744	0.026180
27	PET REFINE	0.011165	-0.000000	0.000990	0.041914	0.000078	0.012346	0.017028	0.005570	0.016143	0.008941
28	GLASS$STONE	0.005367	-0.000000	0.000067	0.000068	0.000001	0.000041	0.000121	0.000151	0.003154	0.000221
29	CEM$CLAY	0.000685	-0.000000	0.000297	0.032201	0.000025	0.000424	0.000441	0.001343	0.002309	0.000467
30	IRON$STEEL	0.000276	-0.000000	0.000124	0.000678	0.000007	0.000486	0.000372	0.000294	0.000566	0.006968
31	NONFER MET	0.000057	-0.000000	0.000033	0.000194	0.000001	0.000054	0.000055	0.000519	0.000076	0.000263
32	ALUMINUM	0.000000	-0.000000	0.000000	0.000000	0.000000	0.000002	0.000001	0.000000	0.000000	0.000000
33	HEA[illegible] METL	0.000310	-0.000000	0.000166	0.000267	0.000019	0.000245	0.000262	0.000201	0.001808	0.000188
34	LITE METL	0.002064	-0.000000	0.002482	0.000661	0.000005	0.001563	0.002432	0.000587	0.003821	0.000536
35	NONELC EQP	0.000018	-0.000000	0.000003	0.000096	0.000000	0.002295	0.000531	0.001157	0.000274	0.000079
36	MACH TOOL	0.000230	-0.000000	0.000042	0.011170	0.000002	0.001313	0.001225	0.001368	0.001902	0.000314
37	NONELC EQP	0.001022	-0.000000	0.000029	0.010941	0.000000	0.002346	0.002226	0.002908	0.000487	0.000283
38	ELEC MACH	0.000064	-0.000000	0.000027	0.000245	0.000012	0.000073	0.000080	0.000067	0.000069	0.000053
39	AEROSPACE	0.000069	-0.000000	0.000005	0.000042	0.000000	0.000131	0.000148	0.000075	0.000066	0.000076
40	MOTOR VEH	0.000106	-0.000000	0.000014	0.000167	0.000001	0.001300	0.000450	0.000254	0.000228	0.000136
41	SHIP BLDG	0.000087	-0.000000	0.000006	0.000058	0.000000	0.000135	0.000154	0.000076	0.000072	0.000079
42	OTHER MFGS	0.000147	-0.000000	0.000041	0.000068	0.000012	0.000070	0.000097	0.000319	0.000077	0.003659
43	TRANSPORT	0.041144	-0.000000	0.003103	0.025308	0.000207	0.078445	0.088665	0.044624	0.039355	0.045612
44	ELEC COMPY	0.004518	-0.000000	0.003300	0.007814	0.000104	0.001346	0.011699	0.007411	0.006106	0.006539
45	GAS COMPY	0.005395	-0.000000	0.000173	0.005689	0.000043	0.000248	0.001179	0.001096	0.001944	0.003878
46	WATER SERV	0.001872	-0.000000	0.000058	0.000119	0.000023	0.000119	0.000171	0.000956	0.000159	0.000169
47	COMMUNICAT	0.008919	-0.000000	0.005519	0.002054	0.004225	0.007576	0.007926	0.007280	0.004903	0.009623
48	P,O $ MISC	0.004975	-0.000000	0.003011	0.001971	0.000242	0.004193	0.004312	0.003382	0.003999	0.002764
49	HOUSING	0.000000	-0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	-0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.043886	-0.000000	0.010625	0.035676	0.000342	0.039572	0.061999	0.040045	0.048866	0.052569
52	FINANCE	0.008286	-0.000000	0.005575	0.007027	0.008237	0.005151	0.005792	0.005698	0.003749	0.005452
53	INSURANCE	0.011531	-0.000000	0.010468	0.013136	0.012330	0.009132	0.013451	0.012169	0.013345	0.013718
54	REA ESTATE	0.001321	-0.000000	0.000603	0.001074	0.000332	0.000977	0.001516	0.001159	0.001280	0.001298
55	BUSI SERV	0.025048	-0.000000	0.010969	0.013809	0.004661	0.007031	0.018004	0.015119	0.015916	0.007922
56	PERS SERV	0.008221	-0.000000	0.005473	0.007801	0.000240	0.007446	0.009985	0.009379	0.009848	0.010145

TABLE A-2
DIRECT AND INDIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS
MATRIX INVERSE

		21 PULPMILLS	22 PAPER MLLS	23 PAPBD MILS	24 PRINT$PUBS	25 INDUS$CHEM	26 OTHER CHEM	27 PET REFINE	28 GLASS$STONE	29 CEM$CLAY	30 IRON$STEEL
1	FIELD CROP	0.000001	0.000001	0.000001	0.000002	0.000001	0.000048	0.000001	0.000002	0.000001	0.000001
2	VEGETABLES	0.000014	0.000008	0.000009	0.000008	0.000004	0.000004	0.000007	0.000007	0.000020	0.000006
3	LVSTK$PROD	0.000042	0.000033	0.000033	0.000078	0.000041	0.002315	0.000015	0.000073	0.000039	0.000016
4	OTHER AGRI	0.000359	0.000154	0.000108	0.000012	0.000001	0.000003	0.000002	0.000010	0.000026	0.000005
5	FISHING	0.000012	0.000007	0.000008	0.000007	0.000004	0.000004	0.000006	0.000006	0.000017	0.000005
6	MEAT PRODS	0.000165	0.000142	0.000140	0.000359	0.000205	0.013133	0.000036	0.000365	0.000122	0.000056
7	DAIRY PROD	0.000029	0.000017	0.000019	0.000034	0.000011	0.000023	0.000019	0.000020	0.000040	0.000014
8	CANN$PRES	0.000103	0.000056	0.000064	0.000059	0.000032	0.000031	0.000053	0.000054	0.000146	0.000041
9	GRAIN MLLS	0.000055	0.000038	0.000040	0.000097	0.000034	0.001141	0.000033	0.000065	0.000064	0.000030
10	BEVERAGES	0.000020	0.000011	0.000012	0.000004	0.000006	0.000004	0.000009	0.000008	0.000029	0.000007
11	OTHR FOODS	0.000077	0.000052	0.000059	0.000159	0.000031	0.000098	0.000050	0.000075	0.000080	0.000085
12	TEXTILES	0.000002	0.000012	0.000857	0.000003	0.000000	0.000013	0.000001	0.000058	0.000023	0.000002
13	APPAREL	0.000290	0.000093	0.000096	0.000036	0.000011	0.000057	0.000021	0.000030	0.000045	0.000032
14	MINING	0.002224	0.001439	0.000411	0.000167	0.000038	0.000141	0.000081	0.012954	0.119853	0.003261
15	FORESTRY	0.043363	0.012822	0.011609	0.000844	0.000012	0.000190	0.000037	0.000880	0.000479	0.000101
16	LOGGING	0.216620	0.062965	0.057655	0.004125	0.000048	0.000930	0.000146	0.004352	0.002077	0.000391
17	SAWMILLS	0.030397	0.013030	0.009108	0.000945	0.000047	0.000214	0.000142	0.000763	0.002007	0.000345
18	PLYWOOD	0.005521	0.006585	0.003655	0.000453	0.000013	0.000072	0.000043	0.000307	0.000146	0.000099
19	OTHER WOOD	0.002127	0.000271	0.000484	0.000121	0.000108	0.000087	0.000559	0.000158	0.000475	0.001926
20	FURN$FIX	0.000017	0.000010	0.000010	0.000011	0.000004	0.000002	0.000011	0.000005	0.000012	0.000018
21	PULPMILLS	1.015594	0.034205	0.144161	0.002406	0.000046	0.001958	0.000090	0.009901	0.003800	0.000265
22	PAPER MLLS	0.002105	1.001222	0.022830	0.063524	0.000166	0.002806	0.000499	0.008955	0.002598	0.000537
23	PAPBD MILS	0.001039	0.013701	1.054669	0.002607	0.000300	0.013734	0.000541	0.070678	0.027327	0.001824
24	PRINT$PUBS	0.002287	0.002214	0.002686	1.024333	0.000808	0.005322	0.000970	0.020252	0.003890	0.003090
25	INDUS$CHEM	0.008665	0.001590	0.002184	0.000308	1.000128	0.008430	0.000797	0.000368	0.000138	0.000031
26	OTHER CHEM	0.007919	0.008349	0.007819	0.025202	0.014506	1.027768	0.000210	0.025945	0.002404	0.002363
27	PET REFINE	0.025226	0.018869	0.023098	0.002857	0.011234	0.010139	1.010061	0.004914	0.076090	0.003764
28	GLASS$STONE	0.000114	0.000055	0.000063	0.000077	0.000039	0.002129	0.000030	1.000070	0.000237	0.015136
29	CEM$CLAY	0.021414	0.001940	0.003420	0.000634	0.000195	0.000176	0.000488	0.008087	1.203784	0.013138
30	IRON$STEEL	0.002669	0.001032	0.001439	0.000256	0.000135	0.000213	0.000341	0.000273	0.009832	1.020536
31	NONFER MET	0.002402	0.000183	0.000422	0.000230	0.000171	0.008260	0.000042	0.000272	0.002338	0.004475
32	ALUMINUM	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000	0.000004	0.000000
33	HEAVY METL	0.002245	0.000920	0.000528	0.000349	0.000103	0.000094	0.000667	0.000204	0.005136	0.000513
34	LITE METL	0.004519	0.001293	0.001923	0.002890	0.000265	0.002479	0.005128	0.000557	0.007553	0.002144
35	NONELC EQP	0.000520	0.000163	0.000146	0.000014	0.000023	0.000005	0.000003	0.000026	0.001617	0.000031
36	MACH TOOL	0.002344	0.000272	0.000451	0.000198	0.000098	0.004364	0.000076	0.000368	0.009614	0.001909
37	NONELC EQP	0.005840	0.004064	0.002736	0.000270	0.004751	0.000126	0.000011	0.000362	0.001478	0.000077
38	ELEC MACH	0.000174	0.000087	0.000086	0.000057	0.000091	0.000046	0.001217	0.000072	0.003390	0.000109
39	AEROSPACE	0.000093	0.000049	0.000056	0.000017	0.000026	0.000017	0.000040	0.000038	0.000134	0.000033
40	MOTOR VEH	0.000420	0.000148	0.000159	0.000036	0.000038	0.000032	0.000440	0.000081	0.003391	0.000118
41	SHIP BLDG	0.000102	0.000056	0.000065	0.000018	0.000030	0.000021	0.000435	0.000040	0.000163	0.000035
42	OTHER MFGS	0.001901	0.000160	0.001236	0.001407	0.000095	0.004428	0.000029	0.000257	0.000124	0.000080
43	TRANSPORT	0.055515	0.029166	0.033576	0.010250	0.015381	0.010255	0.023939	0.022648	0.080211	0.019872
44	ELEC COMPY	0.010595	0.016477	0.012966	0.006328	0.044283	0.003885	0.005579	0.016183	0.012681	0.021745
45	GAS COMPY	0.009052	0.015026	0.009493	0.002309	0.000095	0.000459	0.000512	0.013065	0.006125	0.008972
46	WATER SERV	0.003575	0.000823	0.000619	0.000229	0.000053	0.000096	0.000464	0.000158	0.000196	0.000164
47	COMMUNICAT	0.005743	0.004680	0.004417	0.011762	0.005612	0.003451	0.002081	0.008315	0.007933	0.008100
48	P,O $ MISC	0.008574	0.005010	0.004930	0.005773	0.002008	0.001170	0.005213	0.002505	0.004225	0.009422
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.053201	0.031963	0.039005	0.017614	0.011188	0.015353	0.003098	0.024395	0.046566	0.074836
52	FINANCE	0.008136	0.003592	0.009571	0.007863	0.005537	0.007696	0.003370	0.008306	0.014377	0.008823
53	INSURANCE	0.015162	0.012192	0.013377	0.012252	0.006119	0.010081	0.007052	0.015583	0.016371	0.011095
54	REA ESTATE	0.001363	0.000962	0.001112	0.001646	0.000475	0.000772	0.000566	0.001184	0.001454	0.003384
55	BUSI SERV	0.010429	0.007155	0.008526	0.014362	0.001944	0.008474	0.006790	0.016121	0.010761	0.016061
56	PERS SERV	0.009580	0.007518	0.007807	0.041092	0.005975	0.010045	0.013133	0.015428	0.011571	0.007743

TABLE A-2
DIRECT AND INDIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS
MATRIX INVERSE

		31 NONFER MET	32 ALUMINUM	33 HEAVY METL	34 LITE METL	35 NONELC EQP	36 MACH TOOL	37 NONELC EQP	38 ELEC MACH	39 AEROSPACE	40 MOTOR VEH
1	FIELD CROP	0.000000	0.000000	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000001	0.000003	0.000003	0.000003	0.000002	0.000001	0.000001	0.000001	0.000000	0.000002
3	LVSTK$PROD	0.000003	0.000005	0.000035	0.000015	0.000006	0.000003	0.000004	0.000004	0.000002	0.000011
4	OTHER AGRI	0.000000	0.000001	0.000002	0.000001	0.000001	0.000001	0.000003	0.000001	0.000002	0.000018
5	FISHING	0.000001	0.000003	0.000002	0.000002	0.000002	0.000001	0.000001	0.000001	0.000000	0.000002
6	MEAT PRODS	0.000006	0.000015	0.000179	0.000066	0.000015	0.000008	0.000009	0.000008	0.000009	0.000049
7	DAIRY PROD	0.000005	0.000006	0.000008	0.000008	0.000007	0.000004	0.000005	0.000005	0.000001	0.000005
8	CANN$PRES	0.000009	0.000022	0.000020	0.000019	0.000017	0.000008	0.000011	0.000011	0.000004	0.000014
9	GRAIN MLLS	0.000012	0.000009	0.000029	0.000020	0.000015	0.000011	0.000012	0.000012	0.000003	0.000013
10	BEVERAGES	0.000001	0.000005	0.000003	0.000003	0.000002	0.000001	0.000001	0.000001	0.000001	0.000002
11	OTHR FOODS	0.000036	0.000014	0.000044	0.000033	0.000041	0.000036	0.000034	0.000032	0.000007	0.000023
12	TEXTILES	0.000000	0.000000	0.000001	0.000007	0.000001	0.000001	0.000002	0.000004	0.000001	0.000006
13	APPAREL	0.000007	0.000009	0.000016	0.000012	0.000011	0.000012	0.000030	0.000009	0.000018	0.000030
14	MINING	0.013322	0.000033	0.000572	0.000100	0.000347	0.000301	0.000058	0.000192	0.000056	0.000312
15	FORESTRY	0.000006	0.000008	0.000046	0.000099	0.000020	0.000020	0.000108	0.000090	0.000035	0.000253
16	LOGGING	0.000025	0.000031	0.000204	0.000482	0.000080	0.000078	0.000428	0.000441	0.000128	0.000820
17	SAWMILLS	0.000028	0.000041	0.000102	0.000100	0.000084	0.000103	0.000262	0.000096	0.000154	0.001494
18	PLYWOOD	0.000008	0.000010	0.000034	0.000038	0.000022	0.000025	0.000089	0.000040	0.000283	0.002664
19	OTHER WOOD	0.000036	0.000083	0.000361	0.000080	0.000201	0.000129	0.002301	0.000043	0.000121	0.000210
20	FURN$FIX	0.000002	0.000004	0.000005	0.000002	0.000007	0.000010	0.000006	0.000002	0.000089	0.001256
21	PULPMILLS	0.000021	0.000017	0.000150	0.001154	0.000082	0.000080	0.000354	0.000775	0.000072	0.000242
22	PAPER MLLS	0.000132	0.000127	0.001802	0.000325	0.000195	0.000197	0.000345	0.002576	0.000371	0.000193
23	PAPBD MILS	0.000125	0.000098	0.000746	0.008408	0.000557	0.000542	0.002523	0.005088	0.000442	0.001731
24	PRINT$PUBS	0.000951	0.000721	0.001626	0.000986	0.001154	0.001157	0.003346	0.000959	0.002500	0.000963
25	INDUS$CHEM	0.000017	0.000003	0.000115	0.000054	0.000008	0.000005	0.000012	0.000016	0.000092	0.000032
26	OTHER CHEM	0.000049	0.000081	0.013037	0.004237	0.000372	0.000246	0.000183	0.000120	0.000550	0.003175
27	PET REFINE	0.019634	0.001505	0.004641	0.003034	0.003362	0.000827	0.000766	0.001007	0.001044	0.002282
28	GLASS$STONE	0.000008	0.000009	0.004043	0.002210	0.003167	0.004460	0.000118	0.000088	0.000206	0.002255
29	CEM$CLAY	0.000543	0.000182	0.002251	0.000356	0.001059	0.000807	0.000353	0.000183	0.000407	0.001242
30	IRON$STEEL	0.000059	0.000111	0.166623	0.016815	0.058600	0.025139	0.004967	0.004895	0.000402	0.065134
31	NONFER MET	1.303451	0.000066	0.000925	0.000165	0.009011	0.010795	0.000167	0.015357	0.000449	0.003531
32	ALUMINUM	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000084	0.001230
33	HEAVY METL	0.000085	0.000090	1.006256	0.005883	0.004551	0.000263	0.000207	0.000071	0.000108	0.012685
34	LITE METL	0.000319	0.000155	0.002070	1.046355	0.013834	0.004435	0.004777	0.000111	0.000953	0.013111
35	NONELC EQP	0.000004	0.000003	0.000009	0.000004	1.006478	0.000041	0.004419	0.000004	0.000002	0.000007
36	MACH TOOL	0.000160	0.000019	0.003502	0.004010	0.028638	1.020446	0.002432	0.002420	0.006027	0.000255
37	NONELC EQP	0.000150	0.000005	0.000052	0.000059	0.011116	0.008258	1.015433	0.000049	0.000139	0.000024
38	ELEC MACH	0.000049	0.000055	0.003120	0.000063	0.004511	0.004159	0.004459	1.004729	0.002916	0.000070
39	AEROSPACE	0.000002	0.000022	0.000015	0.000012	0.000011	0.000002	0.000005	0.000005	1.012591	0.000010
40	MOTOR VEH	0.000023	0.000031	0.000043	0.000021	0.000031	0.000020	0.000020	0.000017	0.000006	1.006172
41	SHIP BLDG	0.000010	0.000022	0.000016	0.000013	0.000012	0.000003	0.000006	0.000006	0.000003	0.000011
42	OTHER MFGS	0.000020	0.000014	0.000093	0.000052	0.000052	0.000047	0.002325	0.000028	0.001684	0.001335
43	TRANSPORT	0.001354	0.012877	0.008743	0.007061	0.006287	0.001347	0.003185	0.003181	0.001418	0.005952
44	ELEC COMPY	0.012993	0.055393	0.013150	0.009983	0.007423	0.010856	0.005939	0.006366	0.002449	0.003533
45	GAS COMPY	0.018627	0.000078	0.001622	0.004175	0.000842	0.000555	0.002402	0.002783	0.000653	0.000780
46	WATER SERV	0.000065	0.000038	0.000090	0.000066	0.000071	0.000065	0.000069	0.000077	0.000185	0.000059
47	COMMUNICAT	0.003632	0.000766	0.005511	0.004988	0.003813	0.005374	0.003442	0.005686	0.005597	0.003913
48	P,U $ MISC	0.001287	0.001939	0.002481	0.001206	0.003628	0.005158	0.003087	0.001057	0.002134	0.004841
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.017413	0.013143	0.032041	0.010651	0.025965	0.023961	0.019684	0.015980	0.003019	0.011481
52	FINANCE	0.003440	0.000484	0.008517	0.008845	0.003605	0.005146	0.005326	0.003065	0.001120	0.005074
53	INSURANCE	0.009331	0.013339	0.012320	0.011213	0.010905	0.009751	0.012493	0.008268	0.002695	0.009402
54	REA ESTATE	0.000628	0.000381	0.001258	0.000710	0.000839	0.000763	0.000785	0.003057	0.000187	0.000739
55	BUSI SERV	0.007200	0.001790	0.012103	0.009837	0.004865	0.006272	0.013162	0.008760	0.004990	0.017885
56	PERS SERV	0.006398	0.000832	0.005379	0.006929	0.005890	0.005206	0.005503	0.005607	0.001260	0.003849

TABLE A-2
DIRECT AND INDIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS

MATRIX INVERSE

		41 SHIP BLDG	42 OTHER MFGS	43 TRANSPORT	44 ELEC COMPY	45 GAS COMPY	46 WATER SERV	47 COMMUNICAT	48 P,O $ MISC	49 HOUSING	50 HIGHWAYS
1	FIELD CROP	0.000000	0.000000	0.000011	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000001
2	VEGETABLES	0.000002	0.000003	0.000230	0.000004	0.000001	0.000001	0.000001	0.000007	0.000006	0.000009
3	LVSTK$PROD	0.000013	0.000014	0.000383	0.000009	0.000003	0.000004	0.000003	0.000027	0.000035	0.000023
4	OTHER AGRI	0.000017	0.000089	0.000033	0.000007	0.000004	0.000005	0.000005	0.000214	0.000548	0.000048
5	FISHING	0.000002	0.000002	0.000201	0.000004	0.000001	0.000001	0.000001	0.000006	0.000006	0.000008
6	MEAT PRODS	0.000062	0.000057	0.001125	0.000025	0.000007	0.000009	0.000008	0.000110	0.000162	0.000078
7	DAIRY PROD	0.000005	0.000009	0.000411	0.000011	0.000004	0.000006	0.000004	0.000016	0.000014	0.000020
8	CANN$PRES	0.000014	0.000021	0.001711	0.000033	0.000006	0.000010	0.000008	0.000051	0.000047	0.000070
9	GRAIN MLLS	0.000014	0.000020	0.000551	0.000019	0.000008	0.000013	0.000009	0.000037	0.000037	0.000036
10	BEVERAGES	0.000002	0.000003	0.000356	0.000006	0.000000	0.000000	0.000001	0.000009	0.000009	0.000013
11	OTHR FOODS	0.000024	0.000036	0.000159	0.000034	0.000018	0.000029	0.000023	0.000081	0.000062	0.000058
12	TEXTILES	0.000005	0.000032	0.000008	0.000001	0.000000	0.000000	0.000000	0.000015	0.000012	0.000002
13	APPAREL	0.000525	0.006771	0.000416	0.000061	0.000036	0.000036	0.000042	0.001372	0.001123	0.000053
14	MINING	0.000332	0.000029	0.001064	0.000382	0.000238	0.000259	0.000340	0.011927	0.008960	0.069415
15	FORESTRY	0.000221	0.000449	0.000211	0.000074	0.000041	0.000040	0.000069	0.001817	0.004708	0.000475
16	LOGGING	0.000739	0.001552	0.000761	0.000263	0.000136	0.000128	0.000270	0.005661	0.014532	0.001521
17	SAWMILLS	0.001147	0.003631	0.000872	0.000541	0.000351	0.000380	0.000407	0.017459	0.046041	0.003988
18	PLYWOOD	0.002022	0.000135	0.000254	0.000120	0.000076	0.000081	0.000094	0.003648	0.009400	0.001931
19	OTHER WOOD	0.001045	0.003293	0.004739	0.000367	0.000195	0.000214	0.000221	0.009740	0.025413	0.002051
20	FURN$FIX	0.000474	0.000002	0.000057	0.000056	0.000038	0.000041	0.000040	0.001897	0.001725	0.000008
21	PULPMILLS	0.000205	0.000597	0.000216	0.000072	0.000030	0.000013	0.000097	0.000404	0.000315	0.000318
22	PAPER MLLS	0.000707	0.003434	0.000364	0.001285	0.000319	0.000072	0.002281	0.000743	0.000576	0.000500
23	PAPBD MILS	0.001343	0.003573	0.001499	0.000226	0.000144	0.000080	0.000174	0.002797	0.002180	0.002218
24	PRINT$PUBS	0.001377	0.001156	0.002933	0.004070	0.004572	0.000631	0.003525	0.004085	0.003012	0.002387
25	INDUS$CHEM	0.000044	0.000047	0.000109	0.000013	0.000004	0.007046	0.000010	0.000091	0.000143	0.000069
26	OTHER CHEM	0.004159	0.003431	0.004107	0.000363	0.000271	0.000259	0.000257	0.006091	0.010376	0.002617
27	PET REFINE	0.001519	0.001195	0.078006	0.008846	0.000578	0.000739	0.004235	0.021325	0.017652	0.049323
28	GLASS$STONE	0.000802	0.000038	0.000154	0.000092	0.000064	0.000052	0.000055	0.002335	0.001795	0.002054
29	CEM$CLAY	0.002612	0.000146	0.003063	0.002706	0.001798	0.001962	0.002741	0.090473	0.065137	0.078286
30	IRON$STEEL	0.019746	0.000147	0.002202	0.001674	0.000556	0.000472	0.000598	0.021220	0.017769	0.015098
31	NONFER MET	0.002080	0.000080	0.000134	0.001339	0.000051	0.000063	0.000103	0.002420	0.001664	0.002571
32	ALUMINUM	0.000000	0.000000	0.000002	0.000000	0.000000	0.000000	0.000000	0.000000	0.000340	0.000000
33	HEAVY METL	0.002475	0.000102	0.001327	0.001296	0.000898	0.000924	0.001593	0.041936	0.021339	0.021704
34	LITE METL	0.005050	0.000179	0.003051	0.002336	0.008322	0.000212	0.000231	0.007477	0.006898	0.000961
35	NONELC EQP	0.002356	0.000006	0.000014	0.000007	0.000003	0.000003	0.000006	0.000147	0.000134	0.000119
36	MACH TOOL	0.002579	0.003293	0.000898	0.000154	0.000119	0.000099	0.000113	0.004217	0.003264	0.005013
37	NONELC EQP	0.001485	0.000061	0.000040	0.000016	0.000007	0.000039	0.000017	0.000240	0.000273	0.000819
38	ELEC MACH	0.005664	0.000049	0.000221	0.001059	0.000065	0.000066	0.002757	0.002633	0.001323	0.000386
39	AEROSPACE	0.000010	0.000013	0.001689	0.000027	0.000001	0.000002	0.000003	0.000042	0.000041	0.000063
40	MOTOR VEH	0.000028	0.000023	0.001733	0.000047	0.000008	0.000009	0.000017	0.000341	0.000270	0.000316
41	SHIP BLDG	1.001406	0.000013	0.001706	0.000030	0.000002	0.000002	0.000005	0.000051	0.000048	0.000082
42	OTHER MFGS	0.002480	1.044640	0.000444	0.000068	0.000043	0.000037	0.000740	0.001090	0.000462	0.000090
43	TRANSPORT	0.006043	0.007691	1.008383	0.015855	0.000800	0.000992	0.001812	0.025360	0.024555	0.037432
44	ELEC COMPY	0.003268	0.011867	0.005784	1.170744	0.000346	0.008827	0.006724	0.004458	0.003608	0.003108
45	GAS COMPY	0.000831	0.003378	0.001579	0.000201	1.000108	0.000069	0.000145	0.001037	0.000840	0.001146
46	WATER SERV	0.000521	0.000077	0.000511	0.000087	0.000046	1.000054	0.000067	0.000485	0.000132	0.000154
47	COMMUNICAT	0.003051	0.007701	0.011336	0.004351	0.004673	0.000782	1.008914	0.008960	0.006462	0.006673
48	P,O $ MISC	0.001315	0.001261	0.028788	0.029745	0.019880	0.021757	0.021423	1.003688	0.003036	0.004165
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
51	WHSLE$RET	0.015229	0.011746	0.024124	0.014996	0.002064	0.002310	0.007767	0.068392	0.053406	0.039402
52	FINANCE	0.002752	0.007416	0.004881	0.003864	0.004582	0.007869	0.003378	0.008402	0.006079	0.006480
53	INSURANCE	0.007958	0.011175	0.013934	0.012317	0.008901	0.008105	0.010673	0.013561	0.010375	0.011371
54	REA ESTATE	0.000646	0.000824	0.001322	0.000807	0.000467	0.000527	0.001936	0.001876	0.001300	0.001471
55	BUSI SERV	0.016234	0.021868	0.015576	0.022620	0.013329	0.009123	0.012387	0.040400	0.018198	0.046725
56	PERS SERV	0.003461	0.007640	0.024173	0.006351	0.004694	0.007303	0.004916	0.008013	0.005728	0.007539

TABLE A-2
DIRECT AND INDIRECT REQUIREMENTS 1963
PUGET SOUND AND ADJACENT WATERS

MATRIX INVERSE

		51	52	53	54	55	56
		WHSLE$RET	FINANCE	INSURANCE	REA ESTATE	BUSI SERV	PERS SERV
1	FIELD CROP	0.000001	0.000000	0.000000	0.000001	0.000000	0.000023
2	VEGETABLES	0.000006	0.000004	0.000003	0.000005	0.000003	0.000142
3	LVSTK$PROD	0.000017	0.000011	0.000007	0.000019	0.000010	0.000459
4	OTHER AGRI	0.000005	0.000003	0.000002	0.000020	0.000007	0.000019
5	FISHING	0.000005	0.000004	0.000002	0.000004	0.000003	0.000124
6	MEAT PRODS	0.000037	0.000029	0.000019	0.000066	0.000022	0.000696
7	DAIRY PROD	0.000023	0.000014	0.000007	0.000017	0.000013	0.000745
8	CANN$PRES	0.000042	0.000031	0.000020	0.000038	0.000023	0.001058
9	GRAIN MLLS	0.000112	0.000028	0.000014	0.000037	0.000027	0.001599
10	BEVERAGES	0.000008	0.000004	0.000003	0.000005	0.000002	0.000021
11	OTHR FOODS	0.000825	0.000060	0.000028	0.000080	0.000065	0.003677
12	TEXTILES	0.000005	0.000001	0.000001	0.000002	0.000003	0.000005
13	APPAREL	0.000040	0.000044	0.000028	0.000161	0.000732	0.000083
14	MINING	0.000172	0.000150	0.000062	0.001053	0.000068	0.000321
15	FORESTRY	0.000147	0.000052	0.000036	0.000209	0.000036	0.000085
16	LOGGING	0.000655	0.000217	0.000159	0.000738	0.000160	0.000315
17	SAWMILLS	0.000363	0.000238	0.000106	0.001574	0.000118	0.000484
18	PLYWOOD	0.000111	0.000060	0.000031	0.000347	0.000035	0.000321
19	OTHER WOOD	0.000771	0.000169	0.000090	0.000921	0.000084	0.000326
20	FURN$FIX	0.000025	0.000022	0.000008	0.000165	0.000010	0.000048
21	PULPMILLS	0.000840	0.000164	0.000137	0.000194	0.000086	0.000165
22	PAPER MLLS	0.003721	0.001665	0.001539	0.003594	0.001901	0.001468
23	PAPBD MILS	0.005290	0.000811	0.000641	0.000574	0.000181	0.000867
24	PRINT$PUBS	0.026264	0.024883	0.015848	0.054659	0.018178	0.013546
25	INDUS$CHEM	0.000043	0.000020	0.000017	0.000117	0.000016	0.000052
26	OTHER CHEM	0.000879	0.000764	0.000481	0.003300	0.000557	0.001858
27	PET REFINE	0.013111	0.004291	0.001448	0.031801	0.003311	0.011765
28	GLAS$STONE	0.000206	0.000033	0.000014	0.000216	0.000022	0.000115
29	CEM$CLAY	0.001185	0.001080	0.000417	0.007898	0.000477	0.002329
30	IRON$STEEL	0.000437	0.000235	0.000121	0.001921	0.000352	0.000738
31	NONFER MET	0.000064	0.000042	0.000017	0.000269	0.000023	0.000102
32	ALUMINUM	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000
33	HEAVY METL	0.000924	0.000554	0.000235	0.003759	0.001601	0.001571
34	LITE METL	0.000647	0.000275	0.000146	0.001164	0.000198	0.004464
35	NONELC EQP	0.000169	0.000004	0.000003	0.000018	0.000004	0.000013
36	MACH TOOL	0.000093	0.000074	0.000033	0.000403	0.000047	0.000978
37	NONELC EQP	0.000283	0.000015	0.000012	0.000043	0.000014	0.000040
38	ELEC MACH	0.000135	0.000096	0.000043	0.000324	0.000079	0.000157
39	AEROSPACE	0.000023	0.000017	0.000015	0.000021	0.000009	0.000016
40	MOTOR VEH	0.000689	0.000031	0.000025	0.000075	0.000022	0.000061
41	SHIP BLDG	0.000028	0.000019	0.000015	0.000034	0.000010	0.000023
42	OTHER MFGS	0.000443	0.000707	0.000054	0.000239	0.000766	0.000324
43	TRANSPORT	0.013743	0.010171	0.006971	0.012756	0.005085	0.009331
44	ELEC COMPY	0.018101	0.006138	0.001519	0.031526	0.003527	0.013849
45	GAS COMPY	0.002089	0.001498	0.002164	0.009775	0.001598	0.001129
46	WATER SERV	0.001270	0.000807	0.001115	0.008217	0.000852	0.003350
47	COMMUNICAT	0.025785	0.020805	0.010576	0.013244	0.020425	0.022353
48	P,U $ MISC	0.012597	0.011695	0.004441	0.087383	0.005022	0.025517
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	1.021068	0.014433	0.012017	0.030972	0.016560	0.053692
52	FINANCE	0.013023	1.057618	0.007807	0.012276	0.007945	0.009465
53	INSURANCE	0.010527	0.007967	1.060070	0.024834	0.011250	0.012545
54	REA ESTATE	0.014616	0.016390	0.013232	1.048624	0.012196	0.026111
55	BUSI SERV	0.019343	0.029688	0.026716	0.056627	1.064638	0.028693
56	PERS SERV	0.016005	0.013806	0.005126	0.015999	0.014817	1.037879

THE 1980 PROJECTION MODEL IMPLEMENTATION

Equations (3) through (5) describe the basic projection model while equations (6) through (9) describe, inplicitly, some of the steps in making the projections.

The discussion that follows considers five topics: (1) adjustment of the 54 industry sectors, (2) the treatment of local final demands, such that they become endogenous, (3) the generation of export demands, (4) output determination for "supply oriented" industries, and (5) the estimates of employment and population.

Industry Coefficient Adjustments

Adjustment of the 1963 direct coefficients matrix was an initial step in generating the 1980 projection. Clearly, given this table, the $(I\text{-}A)^{-1}$ table for 1980 could be produced. Here two major problems were involved: (1) allowance for technological change, and (2) adjustments for import substitution.

Technological change is defined here as any factor that causes the a_{ij} to shift. Note that the $a_{ij} \neq r_{ij}$. As defined here, we are not concerned with the components, only the aggregate, a_{ij}.

Changes in the a_{ij}'s were handled in a straightforward manner, we took them all from Clopper Almon. All this means is that whatever changes in the U.S. a_{ij}'s he introduced, we, after conversion to our sectors, adopted. This assumed, of course, that while we did not accept national a_{ij}'s and developed ours from the State of Washington study, we assume the same proportional technological changes will apply to the state area.

Changes in the proportion of any a_{ij} as split between an r_{ij} and m_{ij} do not depend on the changes in the a_{ij}. Rather, they depend on the changes in the aggregate regional demand for <u>i</u>. Thus, the changes in the a_{ij}'s were applied in the same proportion to the r_{ij}'s and m_{ij}'s.

Import substitution is the other type of coefficient adjustment of concern. The notion—let's not quite call it a hypothesis—is that as the regions use of a product grows, relatively more will be produced locally. The presumption is that as the market grows, it becomes feasible to build a plant locally.

As it turns out, all this is quite involved. For example, if you assume <u>i</u> is a homogeneous product, you might wonder why it is currently locally produced as well as imported. In empirical application then, it is useful to recognize product mix within <u>i</u> in order to explain import substitution.

Our method was to compare the Washington industry coefficients to those of a somewhat larger region. In this connection we had available a 1964 input-output-like table for the extended San Francisco Bay Area. Running that matrix for a table showing the direct and indirect ties to local consumption gave us one clue. The assumption is that the ties to consumption, both direct and indirect, are about the same for two regions of the same size. Further, as a region grows, its consumption sector will approximate that of a larger region. Thus, using the San Francisco Bay Area table, we compared our industries' ties with theirs on a sector-by-sector basis.

In making these comparisons, we also compared the percentage employed in each industry for areas such as Boston, Atlanta and Detroit. If these larger sized cities had a consistently higher percentage employed in the industry, they were good candidates for a higher r_{ij}'s.

Finally, in this adjustment process we utilized an unpublished import matrix developed by Philip Bourque and Gerald Hanson. This table was developed after the state study was completed. It went back to the original questionnaires and estimated imports for 46 receiving industries from 43 industries outside of the area. Import coefficients were developed for the state model and we applied the same percentages to estimated PS&AW imports.

The existence of an import matrix, clearly, means we have estimates of the m_{ij}'s. Thus, along with import flows we have import coefficients.

All of the above data were used in estimating changes in the r_{ij}'s at the expense of the m_{ij}'s. Yet it should be confessed that the process indulged a good deal of judgment. Essentially what we did was look at each import now and, with the above data in mind, ask if it seemed to be a good candidate for a greater share of local production. The adjustments, thusly, were really more <u>ad</u> <u>hoc</u>. For the food processing and forest products industries, it was necessary to adjust coefficients downward since projected local outputs of agriculture and fishing as well as logging indicated a local supply constraint.

Local "Final Demands"

In generating the 1980 projection table it was necessary to place the local final demand sectors

within the matrix, i.e., make them endogenous. In effect this meant adding three rows and columns to the 54 by 54 interindustry sectors.

Consumption in 1980 was made a simple function of income originating in the region. Here income in the region is defined as GRP less that fraction that does not become income to people, e.g., depreciation and the like.

Since it is an income originating type of figure, it will differ from the U.S. Department of Commerce's regional income figure. In 1980 it was recognized that part of the income increase would take the form of per capita changes while part would represent extensive growth—as discussed above. Thus column 55 represents average propensities and column 56 marginal propensities.

TABLE A-3. Direct Requirements: PS&AW, 1980 Intermediate Coefficient Table

(Each entry shows the dollars worth of inputs needed from the PS&AW industry named at the left, per dollar of output of the industry named at the top.)

TABLE A-3 DIRECT REQUIREMENTS 1980 -- PUGET SOUND AND ADJACENT WATERS INTERMEDIATE COEFFICIENT TABLE

		1 FLD CRP	2 VEGTBLS	3 LVSTK&PR	4 OTHR AGR	5 FISHNG	6 MT PRDS	7 DARY PRD	8 CAN&PRES	9 GRN MLLS	10 BEVRGS	11 OTHR FDS	12 TEXTLES
1	FIELD CROP	0.024000	0.000800	0.007400	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.007390	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	0.017400	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.131666	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	0.040200	-0.000000	-0.000000	0.168115	0.432618	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	0.017300	-0.000000	0.041700	-0.000000	-0.000000	-0.000000	0.008333	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	0.003915	-0.000000	-0.000000	0.071247	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	0.033261	-0.000000	0.003333	0.016166	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	0.000725	0.142489	0.000833	-0.000000	-0.000000	0.007305	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	0.009167	0.003464	-0.000000	0.004058	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	0.310133	-0.000000	0.006410	0.027536	-0.000000	0.005000	0.033487	-0.000000	0.091599	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	0.000858	-0.000000	-0.000000	0.056918	0.004058	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	0.012821	0.002899	0.008584	0.021667	0.009238	0.009632	0.041396	-0.000000
12	TEXTILES	-0.000000	0.005181	-0.000000	-0.000000	0.012821	-0.000000	-0.000000	-0.000000	0.001155	-0.000000	-0.000000	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	-0.000000	0.013857	-0.000000	-0.000000	-0.000000
14	MINING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001623	-0.000000
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	-0.000000	-0.000000	0.010235	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
19	OTHER WOOD	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	0.000558	0.000299	-0.000000	0.002627	0.000641	-0.000000
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	-0.000000	-0.000000	-0.000000	0.084416	-0.000000	-0.000000	-0.000000	-0.000000	0.001155	-0.000000	0.002435	-0.000000
23	PAPBD MILS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.007971	0.014529	0.027500	0.018476	0.038529	0.031656	-0.000000
24	PRINT$PUBS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000833	-0.000000	0.010595	0.015422	-0.000000
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000341	-0.000000	-0.000000	0.000201	0.000087	-0.000000
26	OTHER CHEM	-0.000000	0.010363	0.005118	0.006494	0.000844	-0.000000	-0.000000	0.000833	0.001444	0.001751	0.001623	0.084299
27	PET REFINE	0.071875	0.041265	0.016480	0.044805	0.045603	-0.000000	0.004292	0.001917	0.001155	0.004030	0.006534	-0.000000
28	GLASS$STONE	-0.000000	-0.000000	-0.000000	0.006494	-0.000000	-0.000000	0.004292	0.006416	-0.000000	0.039405	0.004870	-0.000000
29	CEM$CLAY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
30	IRON$STEEL	0.000108	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
31	NONFER MET	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
32	ALUMINUM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
33	HEAVY METL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000858	-0.000000	-0.000000	0.001751	-0.000000	-0.000000
34	LITE METL	0.000606	0.000204	0.002456	0.000715	0.002699	0.006522	-0.000000	0.087000	-0.000000	0.096063	0.000974	-0.000000
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
36	MACH TOOL	0.031250	0.031088	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000357	-0.000000	-0.000000	-0.000000	-0.000000
37	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001667	-0.000000	0.000876	0.000812	-0.000000
38	ELEC MACH	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	0.025641	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	-0.000000	-0.000000	-0.000000	-0.000000	0.006410	0.000147	-0.000000	-0.000000	-0.000000	0.000061	0.000364	-0.000000
43	TRANSPORT	-0.000000	-0.000000	0.011260	0.006494	0.012821	0.023188	0.027631	0.035000	0.016166	0.034151	0.034091	-0.000000
44	ELEC COMPY	-0.000000	-0.000000	0.012282	0.012587	-0.000000	0.001449	0.002575	0.003333	0.003464	0.002627	0.001623	-0.000000
45	GAS COMPY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002899	0.003433	0.003333	0.003464	0.001751	0.004058	-0.000000
46	WATER SERV	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000725	0.000858	0.001667	0.000320	0.001751	0.001623	-0.000000
47	COMMUNICAT	-0.000000	-0.000000	0.004094	0.006494	0.006410	0.003623	0.002575	0.002500	0.001155	0.010508	0.005682	0.008476
48	P.O $ MISC	0.031250	0.005181	0.011260	0.006494	-0.000000	0.003623	0.003433	0.003333	0.004619	0.007005	0.001623	-0.000000
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	-0.000000	-0.000000	0.014330	0.006494	0.032051	0.025362	0.036052	0.040000	0.016166	0.035902	0.034903	-0.000000
52	FINANCE	0.062500	0.036269	0.081883	0.032468	0.006410	0.003623	0.002575	0.008333	0.005774	0.005254	0.004870	0.008831
53	INSURANCE	0.031250	0.020725	0.009212	0.019481	0.012821	0.003623	0.004292	0.009167	0.006928	0.007881	0.007305	0.010522
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
55	BUSI SERV	-0.000000	-0.000000	-0.000000	0.019481	0.038462	0.010870	0.016309	0.013333	0.016166	0.015762	0.019286	-0.000000
56	PERS SERV	-0.000000	-0.000000	0.014330	0.012987	-0.000000	0.002899	0.005150	0.004167	0.003464	0.004378	0.004058	-0.000000
57	VAL ADD EX	0.468750	0.585492	0.263050	0.530396	0.576923	0.075295	0.103050	0.119607	0.052693	0.094531	0.137881	0.133110
58	VAL ADD IN	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.034305	0.046950	0.054493	0.024007	0.043069	0.062819	0.127890
59	VAL ADD NI	0.127800	0.193000	0.083500	0.161204	0.082500	0.056700	0.107700	0.178300	0.065900	0.357100	0.279800	0.121100

TABLE A-3 DIRECT REQUIREMENTS 1980 -- PUGET SOUND AND ADJACENT WATERS INTERMEDIATE COEFFICIENT TABLE

		13	14	15	16	17	18	19	20	21	22	23	24
		APPAREL	MINING	FORSTRY	LOGGING	SAWMILLS	PLYWOOD	OTHR WD	FURN&FIX	PLP MLLS	PAPR MLS	PPBD MLS	PRNT&PBS
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	0.006453	-0.000000	-0.000000	-0.000000	0.011173	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	0.004329	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002558	-0.000000	-0.000000	0.000812	-0.000000
13	APPAREL	0.056277	-0.000000	-0.000000	0.001062	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
14	MINING	-0.000000	0.005291	0.000551	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001200	-0.000000	-0.000000
15	FORESTRY	-0.000000	-0.000000	0.016797	0.155329	0.033520	0.015020	0.006088	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	0.000676	0.051035	0.179932	0.099556	0.064342	-0.000000	0.173478	0.043628	0.017493	-0.000000
17	SAWMILLS	-0.000000	-0.000000	-0.000000	-0.000000	0.029529	0.013439	0.074581	0.050164	0.031768	0.012660	0.004058	-0.000000
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.052174	0.027397	0.026557	0.005607	0.006662	0.002435	-0.000000
19	OTHER WOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.016743	0.013115	0.001751	0.000221	0.000336	-0.000000
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.013115	-0.000000	-0.000000	-0.000000	-0.000000
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.015152	0.031813	0.133929	-0.000000
22	PAPER MLLS	0.002165	0.001390	-0.000000	-0.000000	-0.000000	-0.000000	0.000548	-0.000000	0.001684	0.000600	0.021104	0.061772
23	PAPBD MILS	0.004329	-0.000000	-0.000000	-0.000000	-0.000000	0.000791	0.001522	0.016393	-0.000000	0.012605	0.051136	0.001166
24	PRINT$PUBS	-0.000000	-0.000000	-0.000000	-0.000000	0.001596	0.000791	0.001522	-0.000000	-0.000000	0.000660	0.000812	0.024360
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001522	-0.000000	0.008418	0.001200	0.000812	-0.000000
26	OTHER CHEM	0.002165	-0.000000	0.000664	-0.000000	0.000798	0.068181	0.001903	0.028689	0.008418	0.009004	0.007103	0.023310
27	PET REFINE	-0.000000	0.042593	0.000199	0.006104	0.007183	-0.000000	0.010654	0.003279	0.019360	0.016567	0.015422	-0.000000
28	GLASS$STONE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003348	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
29	CEM$CLAY	-0.000000	0.026455	-0.000000	-0.000000	0.000798	0.000791	0.001522	-0.000000	0.016835	0.000600	-0.000000	-0.000000
30	IRON$STEEL	-0.000000	0.001402	-0.000000	0.000519	-0.000000	-0.000000	0.000938	0.006885	0.001684	0.000630	0.000812	-0.000000
31	NONFER MET	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001684	-0.000000	-0.000000	-0.000000
32	ALUMINUM	-0.000000	-0.000000	-0.000000	0.000389	-0.000000	-0.000000	0.002494	0.009975	-0.000000	-0.000000	-0.000000	-0.000000
33	HEAVY METL	-0.000000	0.002332	-0.000000	0.000570	-0.000000	-0.000000	0.001522	-0.000000	0.001852	0.000600	0.000044	-0.000000
34	LITE METL	0.002165	0.002713	-0.000000	0.001274	0.001915	-0.000000	0.003653	0.000819	0.003367	0.000992	0.000974	0.002797
35	NONELC EQP	-0.000000	-0.000000	-0.000000	0.002123	-0.000000	0.000791	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
36	MACH TOOL	-0.000000	0.010582	-0.000000	0.001062	0.000789	0.000791	0.001522	-0.000000	0.001684	-0.000000	-0.000000	-0.000000
37	NONELC EQP	-0.000000	0.010582	-0.000000	0.002123	0.001556	0.002372	-0.000000	-0.000000	0.005051	0.003601	0.001623	-0.000000
38	ELEC MACH	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000814	0.000248	0.000132	-0.000000
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	0.001062	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	0.000326	0.000701	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.004112	0.001852	0.000331	0.000893	0.001166
43	TRANSPORT	0.002165	0.021164	-0.000000	0.072187	0.067039	0.030040	0.022831	0.036066	0.033670	0.020408	0.020292	0.006993
44	ELEC COMPY	0.002165	0.005291	-0.000000	0.000345	0.007981	0.004743	0.003044	0.003279	0.006734	0.012605	0.008117	0.003497
45	GAS COMPY	-0.000000	0.005291	-0.000000	-0.000000	0.000798	0.000791	0.001522	0.003279	0.008418	0.014406	0.007305	0.001166
46	WATER SERV	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000791	-0.000000	0.000997	0.003367	0.000600	0.000340	-0.000000
47	COMMUNICAT	0.004329	0.001952	0.003759	0.004246	0.003192	0.003953	0.001522	0.006557	0.001684	0.002401	0.001623	0.009324
48	P,U & MISC	0.002165	0.002098	-0.000000	0.001062	0.000342	0.000791	0.001522	-0.000000	0.005051	0.002401	0.001623	0.003497
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE&RET	0.008658	0.031746	-0.000000	0.033970	0.047885	0.029249	0.036530	0.042623	0.038721	0.024610	0.025974	0.011655
52	FINANCE	0.004329	0.005291	0.007519	0.002123	0.002394	0.003162	0.001522	0.003279	0.005051	0.006603	0.006494	0.005828
53	INSURANCE	0.008658	0.010582	0.011278	0.004246	0.007981	0.007905	0.009132	0.009836	0.010101	0.009004	0.008929	0.009324
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
55	BUSI SERV	0.008658	0.010582	0.003759	0.003185	0.011971	0.010277	0.010654	0.003279	0.005051	0.003601	0.004058	0.010490
56	PERS SERV	0.004329	0.005291	0.001078	0.004246	0.004789	0.005534	0.006088	0.006557	0.005051	0.004802	0.004058	0.037296
57	VAL ADD EX	0.173745	0.104614	0.303552	0.169539	0.136199	0.140849	0.144165	0.293406	0.142604	0.169284	0.124818	0.286305
58	VAL ADD IN	0.093555	0.153586	0.349248	0.155061	0.156701	0.162051	0.166535	0.084694	0.038596	0.045816	0.033782	0.169595
59	VAL ADD NI	0.182800	0.280500	0.279800	0.102600	0.163700	0.100400	0.030200	0.120700	0.193900	0.345500	0.266800	0.144200

TABLE A-3 DIRECT REQUIREMENTS 1980 -- PUGET SOUND AND ADJACENT WATERS INTERMEDIATE COEFFICIENT TABLE

		25 IND&CHEM	26 OTHRCHEM	27 PET RFN	28 GLS&STN	29 CEM&CLAY	30 IRN&STL	31 NONFR MTL	32 ALUMNUM	33 HVY METL	34 LT METL	35 TRANS NONELCEQP	36 MACH TL
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000300	-0.000000	-0.000000	-0.000000	-0.000000
14	MINING	0.001906	-0.000000	-0.000000	0.012048	0.098945	0.001642	0.010121	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	-0.000000	-0.000000	-0.000000	-0.000000	0.001319	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
18	PLYWOOD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
19	OTHER WOOD	0.000315	-0.000000	0.000391	-0.000000	-0.000000	0.001642	-0.000000	0.000858	-0.000000	-0.000000	-0.000000	-0.000000
20	FURN$FIX	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	0.000886	0.002041	0.000391	0.006024	0.001319	-0.000000	-0.000000	-0.000000	0.001504	-0.000000	-0.000000	-0.000000
23	PAPBD MILS	0.000717	0.012245	0.000391	0.066265	0.021108	-0.000000	-0.000000	0.000244	-0.000000	0.007353	-0.000000	-0.000000
24	PRINT$PUBS	0.000356	0.004082	0.000391	0.018072	0.001319	-0.000000	-0.000000	0.000270	-0.000000	-0.000000	-0.000000	-0.000000
25	INDUS$CHEM	0.000541	0.008163	0.000782	-0.000000	-0.000000	0.000221	0.000306	0.000246	0.000174	-0.000000	0.000667	-0.000000
26	OTHER CHEM	0.017524	0.033164	0.000338	0.024096	0.001649	0.001642	0.001579	-0.000000	0.012030	0.004595	-0.000000	-0.000000
27	PET REFINE	0.011500	0.008163	0.006588	-0.000000	0.052770	0.000431	0.014170	0.002166	0.003459	0.001838	0.002128	-0.000000
28	GLASS$STONE	-0.000000	0.002245	-0.000000	0.000834	-0.000000	0.013330	-0.000000	0.000029	0.001654	0.002022	0.002128	0.004781
29	CEM$CLAY	0.000855	-0.000000	-0.000000	0.006024	0.116227	0.008177	-0.000000	0.001457	-0.000000	-0.000000	-0.000000	-0.000000
30	IRON$STEEL	0.001084	-0.000000	-0.000000	-0.000000	0.006926	0.020689	-0.000000	0.002491	0.168947	0.014978	0.055762	0.018322
31	NONFER MET	0.001080	0.006122	-0.000000	-0.000000	0.001385	0.003284	0.244434	0.001250	0.000369	0.007628	0.006702	0.008526
32	ALUMINUM	0.005175	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.012208	0.008074	0.001473	0.003534	0.003067
33	HEAVY METL	0.001215	-0.000000	0.000430	-0.000000	0.003958	0.000144	-0.000000	-0.000000	0.013534	0.005515	0.004681	-0.000000
34	LITE METL	0.001490	0.002302	0.004689	-0.000000	0.006332	0.001970	0.001263	0.000400	0.001265	0.052942	0.015319	0.003944
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	0.001319	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.006383	0.010870
36	MACH TOOL	0.000752	0.006482	-0.000000	-0.000000	0.006596	0.001642	-0.000000	-0.000000	0.003008	0.003823	0.027660	0.021115
37	NONELC EQP	0.004673	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000709	-0.000000	-0.000000	0.010638	0.009562
38	ELEC MACH	0.001145	-0.000000	0.001172	-0.000000	0.003035	0.004310	-0.000000	-0.000000	0.003459	-0.000000	0.004893	0.003984
39	AEROSPACE	0.000469	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	0.000391	-0.000000	0.002639	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	0.000391	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	0.002648	0.004490	0.000135	-0.000000	0.000183	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000470	0.004486
43	TRANSPORT	0.014019	0.008163	0.023056	0.018072	0.060686	0.016420	-0.000000	0.011765	0.004511	0.005515	0.004255	-0.000000
44	ELEC COMPY	0.037383	0.002041	0.004901	0.012048	0.006556	0.016420	0.008097	0.047059	0.007519	0.007353	0.004255	0.007968
45	GAS COMPY	-0.000000	-0.000000	0.000391	0.013012	0.003958	0.008210	0.014170	0.002002	-0.000000	0.003676	-0.000000	-0.000000
46	WATER SERV	0.000637	-0.000000	0.000391	-0.000000	0.000369	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001226
47	COMMUNICAT	0.004673	0.002041	0.001172	0.006024	0.003958	0.004926	0.002024	0.001414	0.003008	0.003676	0.002128	0.003984
48	P,U $ MISC	0.000446	-0.000000	0.003908	-0.000000	-0.000000	0.006568	-0.000000	0.000304	-0.000000	-0.000000	0.002128	0.003984
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.009346	0.012245	0.001172	0.018072	0.030343	0.068966	0.012146	0.011765	0.018045	0.007353	0.019149	0.019920
52	FINANCE	0.004673	0.006122	0.002735	0.006024	0.009235	0.006568	0.002024	0.002947	0.006015	0.007353	0.002128	0.003984
53	INSURANCE	0.004673	0.008163	0.005862	0.012048	0.009235	0.008210	0.006073	0.011765	0.009023	0.009191	0.008511	0.007968
54	REA ESTATE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001642	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
55	BUSI SERV	0.001734	0.006122	0.005080	0.012048	0.003958	0.011494	0.004049	0.003545	0.007519	0.007353	0.002128	0.003984
56	PERS SERV	0.004673	0.008163	0.011723	0.012048	0.005277	0.004926	0.004049	0.004233	0.003008	0.005515	0.004255	0.003984
57	VAL ADD EX	0.116550	0.055914	0.021164	0.166734	0.212863	0.147653	0.092063	0.089907	0.268100	0.237400	0.220350	0.349100
58	VAL ADD IN	0.216450	0.116786	0.018196	0.058766	0.077537	0.193347	0.052237	0.050793	-0.000000	-0.000000	0.050350	-0.000000
59	VAL ADD NI	0.458800	0.133700	0.201000	0.332700	0.078900	0.309500	0.072200	0.235300	0.254300	0.096900	0.271700	0.292000

TABLE A-3 DIRECT REQUIREMENTS 1980 -- PUGET SOUND AND ADJACENT WATERS INTERMEDIATE COEFFICIENT TABLE

		37 IND NONELCEQP	38 ELC MACH	39 AEROSPCE	40 MOTR VEH	41 SHPBLDG	42 OTHR MFG	43 TRANSPRT	44 ELEC COS	45 GAS COS	46 WTR SERV	47 COMCTNS	48 P,O&MSC
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001393	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
12	TEXTILES	-0.000000	-0.000000	0.000036	-0.000000	-0.000000	0.000961	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
13	APPAREL	-0.000000	-0.000000	-0.000000	-0.000000	0.000464	0.006098	0.000331	-0.000000	-0.000000	-0.000000	-0.000000	0.001243
14	MINING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000662	-0.000000	-0.000000	-0.000000	-0.000000	0.002797
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	-0.000000	-0.000000	0.000083	0.001222	0.000855	0.003049	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.015848
18	PLYWOOD	-0.000000	-0.000000	0.000249	0.002445	0.001709	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003108
19	OTHER WOOD	0.002109	-0.000000	0.000083	-0.000000	0.000855	0.003049	0.004300	-0.000000	-0.000000	-0.000000	-0.000000	0.009323
20	FURN$FIX	-0.000000	-0.000000	0.000104	0.001222	0.000580	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001928
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	-0.000000	0.002336	0.000166	-0.000000	0.000464	0.003049	-0.000000	0.000816	-0.000000	-0.000000	0.001988	-0.000000
23	PAPBD MILS	0.002174	0.004673	0.000332	0.001222	0.000929	0.003049	0.000992	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
24	PRINT$PUBS	0.002174	-0.000000	0.002371	-0.000000	0.001022	-0.000000	0.001455	0.002694	0.004280	0.001741	0.002916	0.000932
25	INDUS$CHEM	-0.000000	-0.000000	0.000083	-0.000000	0.000069	-0.000000	-0.000000	0.000149	-0.000000	0.007042	-0.000000	-0.000000
26	OTHER CHEM	-0.000000	0.000995	0.000518	0.002396	0.004970	0.003811	0.004549	-0.000000	-0.000000	-0.000000	-0.000000	0.004343
27	PET REFINE	-0.000000	-0.000000	0.000858	0.001222	0.000534	-0.000000	0.086735	0.005587	-0.000000	-0.000000	0.003644	0.012480
28	GLASS$STONE	-0.000000	0.001790	0.000183	0.001344	0.000510	0.000508	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002052
29	CEM$CLAY	-0.000000	-0.000000	0.000166	-0.000000	0.001858	-0.000000	0.000331	-0.000000	-0.000000	-0.000000	0.000663	0.074580
30	IRON$STEEL	0.004428	0.004907	0.000070	0.061614	0.019508	0.002160	0.001389	0.000857	-0.000000	-0.000000	-0.000000	0.013132
31	NONFER MET	-0.000000	0.012266	0.000284	0.003722	0.001975	0.000127	0.000092	0.000857	-0.000000	-0.000000	-0.000000	0.001632
32	ALUMINUM	0.001499	0.011881	0.001652	0.013158	0.000197	0.017505	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000536
33	HEAVY METL	0.000443	-0.000000	0.000100	0.013448	0.002554	-0.000000	0.000019	-0.000000	-0.000000	0.002013	0.000729	0.041169
34	LITE METL	0.004905	0.001591	0.000866	0.014670	0.005574	0.021952	0.002382	0.002133	0.008282	-0.000000	-0.000000	0.006715
35	NONELC EQP	-0.000000	-0.000000	-0.000000	-0.000000	0.002368	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
36	MACH TOOL	0.002174	0.002336	0.006034	-0.000000	0.002322	0.003049	0.006662	-0.000000	-0.000000	-0.000000	-0.000000	0.003108
37	NONELC EQP	0.008696	-0.000000	0.000083	-0.000000	0.001393	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
38	ELEC MACH	0.005000	0.005374	0.003306	0.002551	0.006410	0.004192	0.000609	0.000938	-0.000000	-0.000000	0.002916	0.002395
39	AEROSPACE	-0.000000	-0.000000	0.012433	-0.000000	-0.000000	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
40	MOTOR VEH	-0.000000	-0.000000	-0.000000	0.006112	-0.000000	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	0.001393	-0.000000	0.001654	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
42	OTHER MFGS	0.002702	-0.000000	0.001733	0.001344	0.002554	0.046951	0.000364	-0.000000	-0.000000	-0.000000	0.000729	0.000942
43	TRANSPORT	0.002174	0.002336	0.001077	0.003667	0.004645	0.006098	0.004631	0.012245	-0.000000	-0.000000	0.000663	0.014916
44	ELEC COMPY	0.004348	0.004673	0.001823	0.001222	0.001858	0.009146	0.003639	0.129322	-0.000000	0.007042	0.005302	0.000622
45	GAS COMPY	0.002174	0.002336	0.000580	-0.000000	0.000464	0.003049	0.001323	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
46	WATER SERV	-0.000000	-0.000000	0.000166	-0.000000	0.000464	-0.000000	0.000331	0.000263	-0.000000	-0.000000	-0.000000	0.000311
47	COMMUNICAT	0.002174	0.004673	0.005139	0.002445	0.001858	0.006098	0.009262	0.002449	0.003891	0.001823	0.007952	0.004972
48	P,U $ MISC	0.002174	-0.000000	0.001741	0.003667	0.000464	-0.000000	0.026795	0.022531	0.015564	0.021127	0.020543	0.001243
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
51	WHSLE$RET	0.017391	0.014019	0.002238	0.004890	0.012076	0.009146	0.019186	0.009796	-0.000000	-0.000000	0.005302	0.057800
52	FINANCE	0.004348	0.002336	0.000829	0.003667	0.001858	0.006098	0.003308	0.002449	0.003891	0.007042	0.002651	0.004972
53	INSURANCE	0.010870	0.007009	0.002155	0.007335	0.006503	0.009146	0.011247	0.008980	0.007782	0.007042	0.009278	0.009012
54	REA ESTATE	-0.000000	0.002336	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001325	-0.000000
55	BUSI SERV	0.010870	0.007009	0.004144	0.014670	0.013934	0.018293	0.011247	0.016327	0.011673	0.007042	0.009940	0.033872
56	PERS SERV	0.004348	0.004673	0.000829	0.002445	0.002322	0.006098	0.021171	0.004082	0.003891	0.007042	0.003976	0.004040
57	VAL ADD EX	0.272911	0.182920	0.343560	0.182875	0.133385	0.264046	0.206807	0.067388	0.098981	0.075225	0.179769	0.262794
58	VAL ADD IN	0.038289	0.157080	0.026460	0.142525	0.045415	0.099154	0.200293	0.123512	0.181419	0.136675	0.251331	0.137806
59	VAL ADD NI	0.266000	0.263700	0.045580	0.007900	0.495500	0.192500	0.332900	0.486300	0.142100	0.539800	0.449000	0.039400

TABLE A-3 DIRECT REQUIREMENTS 1980 -- PUGET SOUND AND ADJACENT WATERS INTERMEDIATE COEFFICIENT TABLE

		49 HOUSING	50 HIGHWYS	51 WHSL&RET	52 FINANCE	53 INSRNCE	54 RL STATE	55 BUS SERV	56 PER SERV	57 AVG PRPNCSM	58 MRGNL PRPNCSM	59 GOV & INVESTMT
1	FIELD CROP	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000014	-0.000006	-0.000000
2	VEGETABLES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000598	-0.000257	-0.000000
3	LVSTK$PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003284	-0.000041	-0.000000
4	OTHER AGRI	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.002232	-0.000960	-0.000000
5	FISHING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000093	0.000025	-0.000000
6	MEAT PRODS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000585	0.019615	0.008631	0.002769
7	DAIRY PROD	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000585	0.016654	0.007328	0.002982
8	CANN$PRES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000974	0.003164	0.001392	0.005183
9	GRAIN MLLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000974	0.001915	0.000843	0.002130
10	BEVERAGES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.009014	0.003966	-0.000000
11	OTHR FOODS	-0.000000	-0.000000	0.000720	-0.000000	-0.000000	-0.000000	-0.000000	0.003313	0.016469	0.007247	0.001846
12	TEXTILES	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000104	0.000106	0.000213
13	APPAREL	0.001018	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000636	-0.000000	0.003647	0.003173	0.000071
14	MINING	0.002374	0.061139	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000069	0.000016	0.000017	0.000213
15	FORESTRY	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000038	0.000017	-0.000000
16	LOGGING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
17	SAWMILLS	0.042402	0.003497	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000087	0.000110	0.000126	0.000213
18	PLYWOOD	0.008141	0.001748	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000195	0.000170	0.000195	0.001775
19	OTHER WOOD	0.024763	0.001748	0.000448	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000161	0.000184	0.001775
20	FURN$FIX	0.001023	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001132	0.001312	0.002840
21	PULPMILLS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
22	PAPER MLLS	-0.000000	-0.000000	0.001839	-0.000000	0.000452	-0.000000	0.000636	0.000390	0.000993	0.000119	0.001562
23	PAPBD MILS	-0.000000	-0.000000	0.004718	0.000557	0.000452	-0.000000	-0.000000	0.000195	0.000150	0.000179	0.000284
24	PRINT$PUBS	0.000678	-0.000000	0.022941	0.021817	0.013628	0.049923	0.016030	0.009540	0.004943	0.004745	0.000639
25	INDUS$CHEM	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000497
26	OTHER CHEM	0.008170	0.001663	-0.000000	-0.000000	-0.000000	0.001404	-0.000000	0.001461	0.000729	0.001363	0.000497
27	PET REFINE	0.010226	0.038512	0.010557	0.002230	-0.000000	0.026786	0.001908	0.008574	0.020252	0.016606	0.005325
28	GLASS$STONE	0.001493	0.001925	0.000160	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000266	0.000234	0.000071
29	CEM$CLAY	0.053556	0.062937	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001031	0.000887	0.000852
30	IRON$STEEL	0.013309	0.010570	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001917
31	NONFER MET	0.001069	0.001835	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000284
32	ALUMINUM	0.001012	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000001	0.000001	0.000994
33	HEAVY METL	0.020842	0.021129	0.000320	-0.000000	-0.000000	-0.000000	0.001272	0.000390	0.000176	0.000232	0.002769
34	LITE METL	0.006267	-0.000000	0.000240	-0.000000	-0.000000	-0.000000	-0.000000	0.003702	0.000235	0.000295	0.002556
35	NONELC EQP	-0.000000	-0.000000	0.000160	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000336	0.000599	0.010082
36	MACH TOOL	0.002374	0.003497	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000779	-0.000000	-0.000000	0.002840
37	NONELC EQP	-0.000000	-0.000000	0.000240	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.003905
38	ELEC MACH	0.001238	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000354	0.000799	0.000994
39	AEROSPACE	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000284
40	MOTOR VEH	-0.000000	-0.000000	0.000640	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.000235	0.000431	0.000710
41	SHIP BLDG	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.001372	0.002511	0.001207
42	OTHER MFGS	0.000349	-0.000000	0.000352	0.000613	-0.000000	-0.000000	0.000700	0.000215	0.000824	0.000395	0.002689
43	TRANSPORT	0.012212	0.027972	0.011596	0.008361	0.007682	0.007653	0.003817	0.006430	0.013316	0.011718	0.006461
44	ELEC COMPY	0.001748	-0.000000	0.014075	0.003902	0.000452	0.024235	0.001908	0.009548	0.009564	0.013294	0.007029
45	GAS COMPY	-0.000000	-0.000000	0.001679	0.001115	0.001808	0.008929	0.001272	0.000585	0.001937	0.002693	0.001065
46	WATER SERV	-0.000000	-0.000000	0.001040	0.000557	0.000904	0.007653	0.000636	0.002923	0.001267	0.001761	0.001420
47	COMMUNICAT	0.003392	0.003503	0.023433	0.017837	0.008586	0.008929	0.017812	0.018706	0.012719	0.021749	0.004899
48	P,U $ MISC	0.001018	0.001748	0.009117	0.008361	0.002259	0.080357	0.002545	0.020655	-0.000000	-0.000000	0.173808
49	HOUSING	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.009347	0.002094	0.179133
50	HIGHWAYS	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	0.036352
51	WHSLE$RET	0.042741	0.029720	0.017035	0.010591	0.009489	0.020408	0.013359	0.047155	0.213866	0.194618	0.012709
52	FINANCE	0.003392	0.003503	0.011116	0.053512	0.006326	0.008929	0.006361	0.007015	0.022964	0.025039	0.009656
53	INSURANCE	0.006445	0.006993	0.007917	0.005574	0.055581	0.019133	0.008906	0.009158	0.021255	0.023168	0.003479
54	REA ESTATE	-0.000000	-0.000000	0.012796	0.013935	0.011297	0.044643	0.010178	0.022798	0.008957	0.011569	0.001704
55	BUSI SERV	0.013229	0.040210	0.014715	0.023969	0.022142	0.044643	0.058524	0.021824	0.005318	0.003031	0.006177
56	PERS SERV	0.002374	0.003503	0.012876	0.010591	0.003163	0.010204	0.012078	0.033905	0.090296	0.094810	0.002485
57	VAL ADD EX	0.226714	0.245344	0.496915	0.434735	0.310393	0.219854	0.502945	0.331864	0.109650	0.034360	0.382851
58	VAL ADD IN	0.118866	0.128656	0.125785	0.080965	0.058807	0.040946	0.088755	0.056736	-0.000000	-0.000000	0.147827
59	VAL ADD NI	0.034000	0.036200	0.186000	0.298000	0.482000	0.374300	0.172900	0.269900	-0.000000	-0.000000	-0.000000

TABLE A–4. Direct requirements: PS&AW, 1980

(Each entry shows the dollars worth of inputs needed from the PS&AW industry named at the left, per dollar of output of the industry named at the top.)

TABLE A-4 DIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		1 FIELD CROP	2 VEGETABLES	3 LVSTK$PROD	4 OTHER AGRI	5 FISHING	6 MEAT PRODS	7 DAIRY PROD	8 CANN$PRES	9 GRAIN MLLS	10 BEVERAGES
1	FIELD CROP	0.047619	0.000000	0.007212	0.000000	0.000000	0.000000	0.000000	0.000000	0.007008	0.000000
2	VEGETABLES	0.000000	0.018692	0.000000	0.000000	0.000000	0.000000	0.000000	0.131590	0.000000	0.000000
3	LVSTK$PROD	0.000000	0.000000	0.040064	0.000000	0.000000	0.133906	0.385052	0.000000	0.000000	0.000000
4	OTHER AGRI	0.000000	0.018692	0.000000	0.042194	0.000000	0.000000	0.000000	0.008279	0.000000	0.000000
5	FISHING	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.000000	0.071460	0.000000	0.000000
6	MEAT PRODS	0.000000	0.000000	0.000000	0.000000	0.006061	0.033047	0.000000	0.003486	0.016118	0.000000
7	DAIRY PROD	0.000000	0.000000	0.000000	0.000000	0.006061	0.000858	0.142268	0.000871	0.000000	0.000000
8	CANN$PRES	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.000000	0.009150	0.003504	0.000000
9	GRAIN MLLS	0.000000	0.000000	0.310096	0.000000	0.006061	0.027468	0.000000	0.004793	0.033637	0.000000
10	BEVERAGES	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.001031	0.000000	0.000000	0.056858
11	OTHR FOODS	0.000000	0.000000	0.000000	0.000000	0.012121	0.003004	0.008763	0.021786	0.009110	0.009549
12	TEXTILES	0.000000	0.006231	0.000000	0.000000	0.012121	0.000000	0.000000	0.000000	0.001402	0.000000
13	APPAREL	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.000000	0.000000	0.014015	0.000000
14	MINING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
15	FORESTRY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
16	LOGGING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17	SAWMILLS	0.000000	0.000000	0.010417	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
18	PLYWOOD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
19	OTHER WOOD	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.000515	0.000436	0.000000	0.002604
20	FURN$FIX	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
21	PULPMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
22	PAPER MLLS	0.000000	0.000000	0.000000	0.080169	0.000000	0.000000	0.000000	0.000000	0.001402	0.000000
23	PAPBD MILS	0.000000	0.000000	0.000000	0.000000	0.000000	0.008155	0.014433	0.027451	0.018220	0.038628
24	PRINT$PUBS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000871	0.000000	0.010417
25	INDUS$CHEM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000515	0.000000	0.000000	0.000000
26	OTHER CHEM	0.000000	0.009346	0.004806	0.008439	0.000000	0.000000	0.000000	0.000871	0.001402	0.001736
27	PET REFINE	0.095238	0.040498	0.016827	0.042194	0.048485	0.000000	0.004124	0.001743	0.001402	0.003906
28	GLASS$STONE	0.000000	0.000000	0.000000	0.008439	0.000000	0.000000	0.004124	0.006536	0.000000	0.039497
29	CEM$CLAY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
30	IRON$STEEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
31	NONFER MET	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
32	ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
33	HEAVY METL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001031	0.000000	0.000000	0.001736
34	LITE METL	0.000000	0.000000	0.002404	0.000000	0.000000	0.006438	0.000000	0.087146	0.000000	0.095920
35	NONELC EQP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
36	MACH TOOL	0.047619	0.031153	0.000000	0.000000	0.000000	0.000000	0.000000	0.000436	0.000000	0.000000
37	NONELC EQP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001743	0.000000	0.000868
38	ELEC MACH	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.000000	0.000000	0.000000	0.000000
39	AEROSPACE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
40	MOTOR VEH	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
41	SHIP BLDG	0.000000	0.000000	0.000000	0.000000	0.024242	0.000000	0.000000	0.000000	0.000000	0.000000
42	OTHER MFGS	0.000000	0.000000	0.000000	0.000000	0.006061	0.000000	0.000000	0.000000	0.000000	0.000000
43	TRANSPORT	0.000000	0.000000	0.011218	0.008439	0.012121	0.023176	0.027835	0.034858	0.016118	0.034288
44	ELEC COMPY	0.000000	0.000000	0.012019	0.012658	0.000000	0.001288	0.002577	0.003486	0.003504	0.002604
45	GAS COMPY	0.000000	0.000000	0.000000	0.000000	0.000000	0.003004	0.003608	0.003486	0.003504	0.001736
46	WATER SERV	0.000000	0.000000	0.000000	0.000000	0.000000	0.000858	0.001031	0.001743	0.000000	0.001736
47	COMMUNICAT	0.000000	0.000000	0.004006	0.008439	0.006061	0.003433	0.002577	0.002614	0.001402	0.010417
48	P,O $ MISC	0.047619	0.006231	0.011218	0.008439	0.000000	0.003433	0.003608	0.003486	0.004905	0.006944
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.000000	0.000000	0.014423	0.008439	0.030303	0.025322	0.036082	0.040087	0.016118	0.036024
52	FINANCE	0.047619	0.037383	0.081731	0.033755	0.006061	0.003433	0.002577	0.008279	0.005606	0.005208
53	INSURANCE	0.047619	0.021807	0.008814	0.021097	0.012121	0.003433	0.004124	0.009150	0.007008	0.007813
54	REA ESTATE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
55	BUSI SERV	0.000000	0.000000	0.000000	0.021097	0.036364	0.010730	0.016495	0.013508	0.016118	0.015625
56	PERS SERV	0.000000	0.000000	0.014423	0.012658	0.000000	0.003004	0.005155	0.004357	0.003504	0.004340

TABLE A-4 DIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		11 OTHR FOODS	12 TEXTILES	13 APPAREL	14 MINING	15 FORESTRY	16 LOGGING	17 SAWMILLS	18 PLYWOOD	19 OTHER WOOD	20 FURN$FIX
1	FIELD CROP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	LVSTK$PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	OTHER AGRI	0.000000	0.000000	0.006243	0.000000	0.000000	0.000000	0.011348	0.000000	0.000000	0.000000
5	FISHING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6	MEAT PRODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
7	DAIRY PROD	0.007099	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8	CANN$PRES	0.004259	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
9	GRAIN MLLS	0.091813	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
10	BEVERAGES	0.004259	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	OTHR FOODS	0.041174	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
12	TEXTILES	0.000000	0.000000	0.004162	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003226
13	APPAREL	0.000000	0.000000	0.056191	0.000000	0.000000	0.001040	0.000000	0.000000	0.000000	0.000000
14	MINING	0.001420	0.000000	0.000000	0.005618	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
15	FORESTRY	0.000000	0.000000	0.000000	0.000000	0.019011	0.195426	0.034043	0.015164	0.006305	0.000000
16	LOGGING	0.000000	0.000000	0.000000	0.000000	0.000000	0.050936	0.180142	0.099761	0.064313	0.000000
17	SAWMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.029787	0.013567	0.074401	0.050000
18	PLYWOOD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.051875	0.027743	0.025806
19	OTHER WOOD	0.000473	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016393	0.012903
20	FURN$FIX	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012903
21	PULPMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
22	PAPER MLLS	0.002366	0.000000	0.002081	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
23	PAPBD MILS	0.031708	0.000000	0.004162	0.000000	0.000000	0.000000	0.000000	0.000798	0.001261	0.016129
24	PRINT$PUBS	0.015618	0.000000	0.000000	0.000000	0.000000	0.000000	0.001418	0.000798	0.001261	0.000000
25	INDUS$CHEM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001261	0.000000
26	OTHER CHEM	0.001420	0.084507	0.002081	0.000000	0.000000	0.000000	0.001418	0.067837	0.002522	0.029032
27	PET REFINE	0.006626	0.000000	0.000000	0.042135	0.000000	0.006237	0.007092	0.000000	0.010088	0.003226
28	GLASS$STONE	0.004733	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003783	0.000000
29	CEM$CLAY	0.000000	0.000000	0.000000	0.025281	0.000000	0.000000	0.001418	0.000798	0.001261	0.000000
30	IRON$STEEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001261	0.006452
31	NONFER MET	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
32	ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002522	0.009677
33	HEAVY METL	0.000000	0.000000	0.000000	0.002809	0.000000	0.001040	0.000000	0.000000	0.001261	0.000000
34	LITE METL	0.000947	0.000000	0.002081	0.002809	0.000000	0.001040	0.001418	0.000000	0.003783	0.001613
35	NONELC EQP	0.000000	0.000000	0.000000	0.000000	0.000000	0.002079	0.000000	0.000798	0.000000	0.000000
36	MACH TOOL	0.000000	0.000000	0.000000	0.011236	0.000000	0.001040	0.001418	0.000798	0.001261	0.000000
37	NONELC EQP	0.000947	0.000000	0.000000	0.011236	0.000000	0.002079	0.001418	0.002394	0.000000	0.000000
38	ELEC MACH	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
39	AEROSPACE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
40	MOTOR VEH	0.000000	0.000000	0.000000	0.000000	0.000000	0.001040	0.000000	0.000000	0.000000	0.000000
41	SHIP BLDG	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
42	OTHER MFGS	0.000473	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004839
43	TRANSPORT	0.034075	0.000000	0.002081	0.022472	0.000000	0.071726	0.066567	0.030327	0.[illegible]2699	0.035484
44	ELEC COMPY	0.001420	0.000000	0.002081	0.005618	0.000000	0.000000	0.008511	0.004789	0.[illegible]2522	0.003226
45	GAS COMPY	0.004259	0.000000	0.000000	0.005618	0.000000	0.000000	0.001418	0.000[illegible]98	0.001261	0.003226
46	WATER SERV	0.001420	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.[illegible]00798	0.000000	0.001613
47	COMMUNICAT	0.005679	0.014085	0.004162	0.002809	0.003802	0.004158	0.002837	0.003990	0.001261	0.006452
48	P,O $ MISC	0.001420	0.000000	0.002081	0.002809	0.000000	0.001040	0.000000	0.000798	0.001261	0.000000
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.035021	0.000000	0.008325	0.030899	0.000000	0.034304	0.048227	0.029529	0.036570	0.041935
52	FINANCE	0.004733	0.014085	0.004162	0.005618	0.007605	0.002079	0.002837	0.003192	0.001261	0.003226
53	INSURANCE	0.007099	0.014085	0.008325	0.011236	0.011407	0.004158	0.008511	0.007981	0.008827	0.009677
54	REA ESTATE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
55	BUSI SERV	0.019404	0.000000	0.008325	0.011236	0.003802	0.003119	0.011348	0.010375	0.010088	0.003226
56	PERS SERV	0.004259	0.000000	0.004162	0.005618	0.000000	0.004158	0.004255	0.005587	0.006305	0.006452

TABLE A-4 DIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		21 PULPMILLS	22 PAPER MLLS	23 PAPBD MILS	24 PRINT$PUBS	25 INDUS$CHEM	26 OTHER CHEM	27 PET REFINE	28 GLASS$STONE	29 CEM$CLAY	30 IRON$STEEL
1	FIELD CROP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	LVSTK$PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	OTHER AGRI	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5	FISHING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6	MEAT PRODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
7	DAIRY PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8	CANN$PRES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
9	GRAIN MLLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
10	BEVERAGES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	OTHR FOODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
12	TEXTILES	0.000000	0.000000	0.000766	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13	APPAREL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14	MINING	0.000000	0.001133	0.000000	0.000000	0.002183	0.000000	0.000000	0.012384	0.099144	0.001577
15	FORESTRY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
16	LOGGING	0.173410	0.043638	0.017625	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17	SAWMILLS	0.031792	0.012751	0.004215	0.000000	0.000000	0.000000	0.000000	0.000000	0.001427	0.000000
18	PLYWOOD	0.005780	0.006301	0.002299	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
19	OTHER WOOD	0.001445	0.000283	0.000383	0.000000	0.000000	0.000000	0.000391	0.000000	0.000000	0.001577
20	FURN$FIX	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
21	PULPMILLS	0.014451	0.031737	0.134100	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
22	PAPER MLLS	0.001445	0.000567	0.021073	0.062061	0.000000	0.002155	0.000391	0.006192	0.001427	0.000000
23	PAPBD MILS	0.000000	0.012468	0.050958	0.001171	0.000000	0.011853	0.000391	0.065015	0.021398	0.000000
24	PRINT$PUBS	0.000000	0.000567	0.000766	0.024590	0.000000	0.004310	0.000391	0.018576	0.001427	0.000000
25	INDUS$CHEM	0.008671	0.001133	0.000766	0.000000	0.000000	0.008621	0.000782	0.000000	0.000000	0.000000
26	OTHER CHEM	0.008671	0.009068	0.007280	0.023419	0.017467	0.033405	0.000391	0.024768	0.001427	0.001577
27	PET REFINE	0.018786	0.016435	0.015326	0.000000	0.010917	0.008621	0.008988	0.000000	0.052782	0.000789
28	GLASS$STONE	0.000000	0.000000	0.000000	0.000000	0.000000	0.002155	0.000000	0.000000	0.000000	0.013407
29	CEM$CLAY	0.017341	0.000567	0.000000	0.000000	0.000000	0.000000	0.000000	0.006192	0.116262	0.007886
30	IRON$STEEL	0.001445	0.000567	0.000766	0.000000	0.000000	0.000000	0.000000	0.000000	0.007133	0.020505
31	NONFER MET	0.001445	0.000000	0.000000	0.000000	0.000000	0.006466	0.000000	0.000000	0.001427	0.003155
32	ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.004367	0.000000	0.000000	0.000000	0.000000	0.000000
33	HEAVY METL	0.001445	0.000567	0.000000	0.000000	0.002183	0.000000	0.000391	0.000000	0.004280	0.000000
34	LITE METL	0.002890	0.001133	0.001149	0.002927	0.002183	0.002155	0.004689	0.000000	0.006419	0.001577
35	NONELC EQP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001427	0.000000
36	MACH TOOL	0.001445	0.000000	0.000000	0.000000	0.000000	0.006466	0.000000	0.000000	0.006419	0.001577
37	NONELC EQP	0.004335	0.003684	0.001533	0.000000	0.004367	0.000000	0.000000	0.000000	0.000000	0.000000
38	ELEC MACH	0.001445	0.000283	0.000000	0.000000	0.002183	0.000000	0.001172	0.000000	0.002853	0.003943
39	AEROSPACE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
40	MOTOR VEH	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000391	0.000000	0.002853	0.000000
41	SHIP BLDG	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000391	0.000000	0.000000	0.000000
42	OTHER MFGS	0.001445	0.000283	0.000766	0.001171	0.002183	0.004310	0.000195	0.000000	0.000000	0.000000
43	TRANSPORT	0.033237	0.020402	0.020307	0.007026	0.013100	0.008621	0.023056	0.018576	0.060628	0.016562
44	ELEC COMPY	0.007225	0.012468	0.008046	0.003513	0.037118	0.002155	0.004885	0.012384	0.006419	0.016562
45	GAS COMPY	0.008671	0.014452	0.007280	0.001171	0.000000	0.000000	0.000391	0.012384	0.004280	0.007886
46	WATER SERV	0.002890	0.000567	0.000383	0.000000	0.000000	0.000000	0.000391	0.000000	0.000713	0.000000
47	COMMUNICAT	0.001445	0.002267	0.001533	0.009368	0.004367	0.002155	0.001172	0.006192	0.004280	0.004732
48	P,O $ MISC	0.004335	0.002267	0.001533	0.003513	0.000000	0.000000	0.003908	0.000000	0.000000	0.006309
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.039017	0.024653	0.026054	0.011710	0.008734	0.011853	0.001172	0.018576	0.030670	0.068612
52	FINANCE	0.004335	0.006517	0.006513	0.005855	0.004367	0.006466	0.002735	0.006192	0.009272	0.006309
53	INSURANCE	0.010116	0.009068	0.008812	0.009368	0.004367	0.008621	0.005862	0.012384	0.009272	0.007886
54	REA ESTATE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001577
55	BUSI SERV	0.004335	0.003684	0.004215	0.010539	0.002183	0.006466	0.005080	0.012384	0.004280	0.011830
56	PERS SERV	0.004335	0.004817	0.004215	0.037471	0.004367	0.008621	0.011723	0.012384	0.004993	0.004732

TABLE A-4 DIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		31 NONFER MET	32 ALUMINUM	33 HEAVY METL	34 LITE METL	35 NONELC EQP	36 MACH TOOL	37 NONELC EQP	38 ELEC MACH	39 AEROSPACE	40 MOTOR VEH
1	FIELD CROP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	LVSTK$PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	OTHER AGRI	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5	FISHING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6	MEAT PRODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
7	DAIRY PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8	CANN$PRES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
9	GRAIN MLLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
10	BEVERAGES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	OTHR FOODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000045	0.000000
12	TEXTILES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13	APPAREL	0.000000	0.000322	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
14	MINING	0.009816	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
15	FORESTRY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
16	LOGGING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000091	0.001204
17	SAWMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000250	0.002408
18	PLYWOOD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002092	0.000000	0.000091	0.000000
19	OTHER WOOD	0.000000	0.000967	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114	0.001204
20	FURN$FIX	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
21	PULPMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002288	0.000159	0.000000
22	PAPER MLLS	0.000000	0.000000	0.001504	0.000000	0.000000	0.000000	0.000000	0.004577	0.000341	0.001204
23	PAPRD MLLS	0.000000	0.000322	0.000000	0.006926	0.000000	0.000000	0.002092	0.004577	0.000341	0.001204
24	PRINT$PUBS	0.000000	0.000322	0.000000	0.000000	0.000000	0.000000	0.002092	0.000000	0.002366	0.000000
25	INDUS$CHEM	0.000000	0.000322	0.000000	0.000000	0.001037	0.000000	0.000000	0.000000	0.000091	0.000000
26	OTHER CHEM	0.001227	0.000000	0.012030	0.004329	0.000000	0.000000	0.000000	0.001144	0.000523	0.002408
27	PET REFINE	0.014724	0.002255	0.003759	0.001732	0.002075	0.000000	0.000000	0.000000	0.000864	0.001204
28	GLASS$STONE	0.000000	0.000000	0.001504	0.001732	0.002075	0.004651	0.000000	0.002288	0.000182	0.001204
29	CEM$CLAY	0.000000	0.001611	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000159	0.000000
30	IRON$STEEL	0.000000	0.002578	0.169173	0.014719	0.056017	0.018605	0.004184	0.004577	0.000068	0.061409
31	NONFER MET	0.244172	0.001289	0.000000	0.007792	0.006224	0.007752	0.000000	0.012586	0.000273	0.003612
32	ALUMINUM	0.000000	0.012246	0.008271	0.001732	0.003112	0.003101	0.001046	0.011442	0.001660	0.013245
33	HEAVY METL	0.000000	0.000000	0.013534	0.005195	0.005187	0.000000	0.000000	0.000000	0.000091	0.013245
34	LITE METL	0.001227	0.000322	0.001504	0.052814	0.015560	0.004651	0.005230	0.001144	0.000864	0.014449
35	NONELC EQP	0.000000	0.000000	0.000000	0.000000	0.006224	0.010853	0.000000	0.000000	0.000000	0.000000
36	MACH TOOL	0.000000	0.000000	0.003008	0.003463	0.028008	0.021705	0.002092	0.002288	0.006028	0.000000
37	NONELC EQP	0.000000	0.000645	0.000000	0.000000	0.010373	0.009302	0.008368	0.000000	0.000091	0.000000
38	ELEC MACH	0.000000	0.000000	0.003759	0.000000	0.005187	0.004651	0.005230	0.005721	0.003298	0.002408
39	AEROSPACE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012442	0.000000
40	MOTOR VEH	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006020
41	SHIP BLDG	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
42	OTHER MFGS	0.000000	0.000000	0.000000	0.000000	0.000000	0.004651	0.003138	0.000000	0.001729	0.001204
43	TRANSPORT	0.000000	0.011924	0.004511	0.005195	0.004149	0.000000	0.002092	0.002288	0.001069	0.003612
44	ELEC COMPY	0.008589	0.047051	0.007519	0.006926	0.004149	0.007752	0.004184	0.004577	0.001820	0.001204
45	GAS COMPY	0.014724	0.001934	0.000000	0.003463	0.000000	0.000000	0.002092	0.002288	0.000569	0.000000
46	WATER SERV	0.000000	0.000000	0.000000	0.000000	0.000000	0.001550	0.000000	0.000000	0.000159	0.000000
47	COMMUNICAT	0.002454	0.001289	0.003008	0.003463	0.002075	0.004651	0.002092	0.004577	0.005141	0.002408
48	P,U $ MISC	0.000000	0.000322	0.000000	0.000000	0.002075	0.004651	0.002092	0.000000	0.001751	0.003612
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.012270	0.011924	0.018045	0.006926	0.018672	0.020155	0.017782	0.013730	0.002229	0.004816
52	FINANCE	0.002454	0.002900	0.006015	0.006926	0.002075	0.004651	0.004184	0.002288	0.000819	0.003612
53	INSURANCE	0.006135	0.011924	0.009023	0.009524	0.008299	0.007752	0.010460	0.006865	0.002161	0.007225
54	REA ESTATE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002288	0.000000	0.000000
55	BUSI SERV	0.003681	0.003545	0.007519	0.006926	0.002075	0.004651	0.010460	0.006865	0.004140	0.014449
56	PERS SERV	0.003681	0.004189	0.003008	0.005195	0.004149	0.004651	0.004184	0.004577	0.000819	0.002408

TABLE A-4 DIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		41 SHIP BLDG	42 OTHER MFGS	43 TRANSPORT	44 ELEC COMPY	45 GAS COMPY	46 WATER SERV	47 COMMUNICAT	48 P,O $ MISC	49 HOUSING	50 HIGHWAYS
1	FIELD CROP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	LVSTK$PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	OTHER AGRI	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5	FISHING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6	MEAT PRODS	0.000000	0.000000	0.001427	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
7	DAIRY PROD	0.000000	0.000000	0.000357	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
8	CANN$PRES	0.000000	0.000000	0.001605	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
9	GRAIN MLLS	0.000000	0.000000	0.000357	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
10	BEVERAGES	0.000000	0.000000	0.000357	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	OTHR FOODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
12	TEXTILES	0.000000	0.001422	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13	APPAREL	0.000410	0.005690	0.000357	0.000000	0.000000	0.000000	0.000000	0.001242	0.001010	0.000000
14	MINING	0.000000	0.000000	0.000714	0.000000	0.000000	0.000000	0.000000	0.002794	0.002356	0.061107
15	FORESTRY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
16	LOGGING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17	SAWMILLS	0.000320	0.002845	0.000000	0.000000	0.000000	0.000000	0.000000	0.015831	0.042403	0.003303
18	PLYWOOD	0.001641	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003104	0.008077	0.001652
19	OTHER WOOD	0.000820	0.002845	0.004281	0.000000	0.000000	0.000000	0.000000	0.009312	0.024735	0.001652
20	FURN$FIX	0.000410	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001862	0.001010	0.000000
21	PULPMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
22	PAPER MLLS	0.000410	0.002845	0.000000	0.000803	0.000000	0.000000	0.001953	0.000000	0.000000	0.000000
23	PAPBD MILS	0.000820	0.002845	0.001070	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
24	PRINT$PUBS	0.000820	0.000000	0.001427	0.002810	0.004057	0.000000	0.002930	0.000931	0.000673	0.000000
25	INDUS$CHEM	0.000000	0.000000	0.000000	0.000000	0.000000	0.007519	0.000000	0.000000	0.000000	0.000000
26	OTHER CHEM	0.004922	0.004267	0.004638	0.000000	0.000000	0.000000	0.000000	0.004346	0.008245	0.001652
27	PET REFINE	0.000410	0.000000	0.086693	0.005620	0.000000	0.000000	0.003581	0.012417	0.010264	0.038811
28	GLASS$STONE	0.000410	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002018	0.001514	0.001652
29	CEM$CLAY	0.002051	0.000000	0.000357	0.000000	0.000000	0.000000	0.000651	0.074655	0.053677	0.062758
30	IRON$STEEL	0.019688	0.002845	0.001427	0.000803	0.000000	0.000000	0.000000	0.013193	0.013293	0.010735
31	NONFER MET	0.002051	0.000000	0.000178	0.000803	0.000000	0.000000	0.000000	0.001707	0.001010	0.001652
32	ALUMINUM	0.000000	0.017070	0.000000	0.000000	0.000000	0.000000	0.000000	0.000466	0.001010	0.000000
33	HEAVY METL	0.002461	0.000000	0.000000	0.000000	0.000000	0.003759	0.000651	0.041130	0.020865	0.021470
34	LITE METL	0.005742	0.021337	0.002319	0.002007	0.008114	0.000000	0.000000	0.006674	0.006226	0.000000
35	NONELC EQP	0.002461	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
36	MACH TOOL	0.002461	0.002845	0.006600	0.000000	0.000000	0.000000	0.000000	0.003104	0.002356	0.003303
37	NONELC EQP	0.001231	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
38	ELEC MACH	0.006563	0.004267	0.000535	0.000803	0.000000	0.000000	0.002930	0.002328	0.001178	0.000000
39	AEROSPACE	0.000000	0.000000	0.001605	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
40	MOTOR VEH	0.000000	0.000000	0.001605	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
41	SHIP BLDG	0.001231	0.000000	0.001605	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
42	OTHER MFGS	0.002461	0.046942	0.000357	0.000000	0.000000	0.000000	0.000651	0.000931	0.000337	0.000000
43	TRANSPORT	0.004512	0.005690	0.004638	0.012445	0.000000	0.000000	0.000651	0.014900	0.012283	0.028076
44	ELEC COMPY	0.002051	0.008535	0.003568	0.129265	0.000000	0.007519	0.005208	0.000621	0.001683	0.000000
45	GAS COMPY	0.000410	0.002845	0.001249	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
46	WATER SERV	0.000410	0.000000	0.000357	0.000401	0.000000	0.000000	0.000000	0.000310	0.000000	0.000000
47	COMMUNICAT	0.002051	0.005690	0.009276	0.002409	0.004057	0.000000	0.007813	0.004967	0.003365	0.003303
48	P,O $ MISC	0.000410	0.000000	0.026757	0.022481	0.016227	0.022556	0.020508	0.001242	0.001010	0.001652
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.011895	0.008535	0.019265	0.009635	0.000000	0.000000	0.005208	0.057737	0.042739	0.029727
52	FINANCE	0.002051	0.005690	0.003389	0.002409	0.004057	0.007519	0.002604	0.004967	0.003365	0.003303
53	INSURANCE	0.006563	0.008535	0.011238	0.008832	0.008114	0.007519	0.009440	0.009002	0.006394	0.006606
54	REA ESTATE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001302	0.000000	0.000000	0.000000
55	BUSI SERV	0.013946	0.018492	0.011238	0.016459	0.012170	0.007519	0.010091	0.033835	0.013293	0.040462
56	PERS SERV	0.002461	0.005690	0.021227	0.004014	0.004057	0.007519	0.003906	0.004035	0.002356	0.003303

TABLE A-4 DIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		51 WHSLE$RET	52 FINANCE	53 INSURANCE	54 REA ESTATE	55 BUSI SERV	56 PERS SERV
1	FIELD CROP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3	LVSTK$PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4	OTHER AGRI	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5	FISHING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6	MEAT PRODS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000630
7	DAIRY PROD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000630
8	CANN$PRES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000945
9	GRAIN MLLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000945
10	BEVERAGES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	OTHR FOODS	0.000705	0.000000	0.000000	0.000000	0.000000	0.003361
12	TEXTILES	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
13	APPAREL	0.000000	0.000000	0.000000	0.000000	0.000678	0.000000
14	MINING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000105
15	FORESTRY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
16	LOGGING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
17	SAWMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000105
18	PLYWOOD	0.000000	0.000000	0.000000	0.000000	0.000000	0.000210
19	OTHER WOOD	0.000441	0.000000	0.000000	0.000000	0.000000	0.000000
20	FURN$FIX	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
21	PULPMILLS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
22	PAPER MLLS	0.001851	0.000000	0.000451	0.000000	0.000678	0.000420
23	PAPBD MILS	0.004715	0.000592	0.000451	0.000000	0.000000	0.000210
24	PRINT$PUBS	0.022958	0.021893	0.013523	0.049872	0.015921	0.009559
25	INDUS$CHEM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
26	OTHER CHEM	0.000000	0.000000	0.000000	0.001279	0.000000	0.001471
27	PET REFINE	0.010575	0.002367	0.000000	0.026854	0.002033	0.008613
28	GLAS$STONE	0.000176	0.000000	0.000000	0.000000	0.000000	0.000000
29	CEM$CLAY	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
30	IRON$STEEL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
31	NONFER MET	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
32	ALUMINUM	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
33	HEAVY METL	0.000308	0.000000	0.000000	0.000000	0.001355	0.000420
34	LITE METL	0.000220	0.000000	0.000000	0.000000	0.000000	0.003676
35	NONELC EQP	0.000176	0.000000	0.000000	0.000000	0.000000	0.000000
36	MACH TOOL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000735
37	NONELC EQP	0.000220	0.000000	0.000000	0.000000	0.000000	0.000000
38	ELEC MACH	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
39	AEROSPACE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
40	MOTOR VEH	0.000661	0.000000	0.000000	0.000000	0.000000	0.000000
41	SHIP BLDG	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
42	OTHER MFGS	0.000353	0.000592	0.000000	0.000000	0.000678	0.000210
43	TRANSPORT	0.011589	0.008284	0.007663	0.007673	0.003726	0.006408
44	ELEC COMPY	0.014057	0.003846	0.000451	0.024297	0.002033	0.009559
45	GAS COMPY	0.001674	0.001183	0.001803	0.008951	0.001355	0.000630
46	WATER SERV	0.001058	0.000592	0.000902	0.007673	0.000678	0.002941
47	COMMUNICAT	0.023442	0.017751	0.008564	0.008951	0.017954	0.018697
48	P.O $ MISC	0.009121	0.008284	0.002254	0.080563	0.002710	0.020693
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.017053	0.010651	0.009466	0.020460	0.013211	0.047164
52	FINANCE	0.011104	0.053550	0.006311	0.008951	0.006436	0.007038
53	INSURANCE	0.007932	0.005621	0.055668	0.019182	0.008808	0.009139
54	REA ESTATE	0.012779	0.013905	0.011269	0.044757	0.010163	0.022794
55	BUSI SERV	0.014718	0.023964	0.022087	0.044757	0.058604	0.021849
56	PERS SERV	0.012867	0.010651	0.003155	0.010230	0.012195	0.033929

TABLE A-5. Direct and indirect requirements: PS&AW, 1980

(Each entry shows for the industry named at the left the dollars worth of output required directly and indirectly per dollar of delivery to final demand of the industry named at the top.)

TABLE A-5 DIRECT AND INDIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		1 FIELD CROP	2 VEGETABLES	3 LVSTK$PROD	4 OTHER AGRI	5 FISHING	6 MEAT PRODS	7 DAIRY PROD	8 CANN$PRES	9 GRAIN MLLS	10 BEVERAGES
1	FIELD CROP	1.050000	0.000000	0.010360	0.000000	0.000095	0.001659	0.004659	0.000071	0.007650	0.000008
2	VEGETABLES	0.000001	1.019048	0.000168	0.000005	0.000841	0.000046	0.000091	0.135423	0.000503	0.000017
3	LVSTK$PROD	0.000003	0.000002	1.042545	0.000012	0.003813	0.144882	0.468073	0.001308	0.002465	0.000057
4	OTHER AGRI	0.000011	0.019889	0.000184	1.044071	0.000122	0.000033	0.000088	0.011382	0.000147	0.000012
5	FISHING	0.000001	0.000000	0.000090	0.000003	1.006549	0.000025	0.000049	0.072606	0.000270	0.000009
6	MEAT PRODS	0.000009	0.000004	0.005634	0.000032	0.006507	1.035498	0.002605	0.004300	0.017334	0.000085
7	DAIRY PROD	0.000004	0.000002	0.000058	0.000019	0.007243	0.001088	1.166002	0.001766	0.000118	0.000112
8	CANN$PRES	0.000011	0.000005	0.001253	0.000039	0.006274	0.000341	0.000677	1.009886	0.003749	0.000125
9	GRAIN MLLS	0.000007	0.000004	0.335052	0.000033	0.009009	0.076328	0.151473	0.008314	1.037078	0.001056
10	BEVERAGES	0.000002	0.000001	0.000024	0.000006	0.006541	0.000030	0.001347	0.000593	0.000054	1.060349
11	OTHR FOODS	0.000015	0.000009	0.003320	0.000071	0.013140	0.004039	0.012237	0.024045	0.010032	0.010640
12	TEXTILES	0.000001	0.006350	0.000498	0.000002	0.012257	0.000121	0.000240	0.001764	0.001540	0.000039
13	APPAREL	0.000077	0.000015	0.005018	0.000047	0.006687	0.001167	0.002309	0.000638	0.015435	0.000065
14	MINING	0.000606	0.000101	0.000223	0.000369	0.000071	0.000121	0.000290	0.000271	0.000120	0.000755
15	FORESTRY	0.000090	0.000036	0.000920	0.001020	0.000201	0.000238	0.000631	0.000368	0.000237	0.000574
16	LOGGING	0.000258	0.000146	0.002585	0.004812	0.000673	0.000866	0.002154	0.001699	0.001109	0.002603
17	SAWMILLS	0.000911	0.000162	0.011575	0.001431	0.000628	0.001804	0.005549	0.000546	0.000372	0.000870
18	PLYWOOD	0.000193	0.000043	0.000099	0.000675	0.000246	0.000073	0.000160	0.000184	0.000113	0.000301
19	OTHER WOOD	0.000562	0.000103	0.000282	0.000226	0.006399	0.000225	0.000997	0.001216	0.000184	0.003150
20	FURN$FIX	0.000098	0.000014	0.000032	0.000022	0.000014	0.000014	0.000027	0.000015	0.000013	0.000019
21	PULPMILLS	0.000049	0.000095	0.000992	0.002988	0.000238	0.001495	0.003031	0.004404	0.002899	0.006561
22	PAPER MLLS	0.000265	0.001767	0.001011	0.084168	0.000445	0.000570	0.001182	0.002110	0.002136	0.002369
23	PAPBD MILS	0.000296	0.000279	0.007048	0.002038	0.001645	0.010849	0.021995	0.031866	0.020797	0.047659
24	PRINT$PUBS	0.002475	0.001565	0.003691	0.002717	0.002436	0.001851	0.003881	0.003959	0.001497	0.014503
25	INDUS$CHEM	0.000088	0.000131	0.000088	0.000253	0.000071	0.000046	0.000702	0.000129	0.000067	0.000163
26	OTHER CHEM	0.000447	0.010732	0.006175	0.010476	0.001579	0.001238	0.003409	0.003826	0.002106	0.004627
27	PET REFINE	0.102579	0.043148	0.022585	0.048175	0.051721	0.006249	0.019355	0.016943	0.005012	0.010099
28	GLASSSTONE	0.000385	0.000372	0.000098	0.008870	0.000470	0.000073	0.004993	0.007094	0.000107	0.042210
29	CEM$CLAY	0.004423	0.000656	0.001492	0.001167	0.000255	0.000696	0.001328	0.000808	0.000665	0.001363
30	IRON$STEEL	0.002167	0.000825	0.000500	0.000382	0.000697	0.000366	0.000683	0.001929	0.000241	0.002429
31	NONFER MET	0.000695	0.000462	0.000167	0.000160	0.000226	0.000131	0.000127	0.001121	0.000067	0.001229
32	ALUMINUM	0.000225	0.000120	0.000030	0.000021	0.000214	0.000026	0.000041	0.000218	0.000013	0.000238
33	HEAVY METL	0.002247	0.000349	0.000783	0.000621	0.000278	0.000411	0.001917	0.000891	0.000347	0.002957
34	LITE METL	0.001234	0.000500	0.003315	0.000650	0.002011	0.007725	0.001978	0.093530	0.000773	0.107908
35	NONELC EQP	0.000569	0.000358	0.000021	0.000018	0.000072	0.000013	0.000024	0.000078	0.000013	0.000025
36	MACH TOOL	0.051384	0.032584	0.000813	0.000244	0.000283	0.000357	0.000655	0.005467	0.000578	0.000786
37	NONELC EQP	0.000501	0.000320	0.000063	0.000354	0.000080	0.000047	0.000104	0.001949	0.000084	0.001084
38	ELEC MACH	0.000532	0.000240	0.000133	0.000180	0.006434	0.000074	0.000143	0.000599	0.000061	0.000153
39	AEROSPACE	0.000008	0.000003	0.000035	0.000023	0.000026	0.000047	0.000072	0.000067	0.000031	0.000067
40	MOTOR VEH	0.000065	0.000024	0.000068	0.000060	0.000071	0.000074	0.000124	0.000110	0.000050	0.000108
41	SHIP BLDG	0.000048	0.000020	0.000045	0.000041	0.024478	0.000049	0.000080	0.001835	0.000040	0.000071
42	OTHER MFGS	0.000375	0.000260	0.000162	0.000173	0.006558	0.000083	0.000170	0.000645	0.000089	0.000179
43	TRANSPORT	0.004672	0.002152	0.021252	0.014010	0.016293	0.028788	0.044532	0.040929	0.019291	0.041483
44	ELEC COMPY	0.001747	0.001264	0.017516	0.017793	0.001678	0.005052	0.012899	0.007112	0.005235	0.006720
45	GAS COMPY	0.000320	0.000189	0.001601	0.001609	0.000475	0.003707	0.005415	0.004681	0.004089	0.003514
46	WATER SERV	0.000256	0.000139	0.000231	0.000238	0.000197	0.001017	0.001468	0.001994	0.000139	0.002040
47	COMMUNICAT	0.002532	0.001715	0.008289	0.011640	0.008942	0.006336	0.009167	0.006659	0.003211	0.014560
48	P,O $ MISC	0.051804	0.007548	0.016880	0.011371	0.001865	0.007572	0.013999	0.007304	0.006973	0.010170
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.006266	0.002594	0.026318	0.015080	0.035176	0.032880	0.058033	0.049678	0.020638	0.045808
52	FINANCE	0.054328	0.041767	0.093820	0.039066	0.008565	0.017852	0.046668	0.017754	0.007881	0.008730
53	INSURANCE	0.055284	0.025256	0.015188	0.026211	0.015457	0.007329	0.013804	0.017757	0.009705	0.013066
54	REA ESTATE	0.001669	0.001022	0.002501	0.001788	0.001325	0.001143	0.002348	0.001585	0.000854	0.001376
55	BUSI SERV	0.005881	0.003114	0.011412	0.027669	0.042408	0.015655	0.028242	0.022504	0.020156	0.022569
56	PERS SERV	0.002970	0.001856	0.019717	0.016646	0.002824	0.007577	0.017392	0.008372	0.005423	0.009121

TABLE A-5 DIRECT AND INDIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		11 OTHR FOODS	12 TEXTILES	13 APPAREL	14 MINING	15 FORESTRY	16 LOGGING	17 SAWMILLS	18 PLYWOOD	19 OTHER WOOD	20 FURN$FIX
1	FIELD CROP	0.000768	0.000000	0.000000	0.000000	0.000000	0.000001	0.000001	0.000000	0.000000	0.000000
2	VEGETABLES	0.000660	0.000000	0.000001	0.000007	0.000000	0.000018	0.000020	0.000011	0.000009	0.000011
3	LVSTK$PROD	0.003725	0.000001	0.000003	0.000013	0.000000	0.000032	0.000036	0.000020	0.000018	0.000021
4	OTHER AGRI	0.000072	0.000000	0.006908	0.000003	0.000000	0.000011	0.012216	0.000178	0.000931	0.000640
5	FISHING	0.000354	0.000000	0.000001	0.000004	0.000000	0.000010	0.000011	0.000006	0.000005	0.000006
6	MEAT PRODS	0.001761	0.000003	0.000008	0.000046	0.000000	0.000120	0.000133	0.000071	0.000063	0.000073
7	DAIRY PROD	0.008675	0.000001	0.000005	0.000018	0.000000	0.000038	0.000043	0.000026	0.000024	0.000027
8	CANN$PRES	0.004921	0.000003	0.000010	0.000052	0.000001	0.000132	0.000147	0.000080	0.000071	0.000082
9	GRAIN MLLS	0.100504	0.000003	0.000010	0.000029	0.000000	0.000056	0.000064	0.000040	0.000038	0.000043
10	BEVERAGES	0.004743	0.000000	0.000001	0.000010	0.000000	0.000030	0.000033	0.000017	0.000015	0.000017
11	OTHR FOODS	1.044207	0.000006	0.000026	0.000057	0.000001	0.000059	0.000082	0.000065	0.000073	0.000076
12	TEXTILES	0.000186	1.000001	0.004414	0.000001	0.000000	0.000006	0.000002	0.000003	0.000002	0.003290
13	APPAREL	0.001542	0.000005	1.059551	0.000029	0.000004	0.001202	0.000267	0.000160	0.000128	0.000079
14	MINING	0.001669	0.000022	0.000043	1.008611	0.000003	0.000110	0.000285	0.000182	0.000294	0.000112
15	FORESTRY	0.000445	0.000016	0.000085	0.000029	1.019381	0.209928	0.074781	0.039497	0.027063	0.005363
16	LOGGING	0.002091	0.000074	0.000398	0.000106	0.000005	1.053748	0.195796	0.113826	0.087056	0.014922
17	SAWMILLS	0.000589	0.000028	0.000138	0.000157	0.000005	0.000109	1.030835	0.014854	0.078487	0.053876
18	PLYWOOD	0.000201	0.000009	0.000050	0.000031	0.000001	0.000033	0.000043	1.054746	0.029781	0.028048
19	OTHER WOOD	0.000801	0.000014	0.000050	0.000226	0.000003	0.000405	0.000451	0.000249	1.016900	0.013583
20	FURN$FIX	0.000009	0.000001	0.000005	0.000010	0.000000	0.000009	0.000008	0.000007	0.000007	1.013077
21	PULPMILLS	0.005340	0.000166	0.000751	0.000143	0.000004	0.000056	0.000122	0.000310	0.000303	0.002487
22	PAPER MLLS	0.004790	0.000328	0.002968	0.000301	0.000048	0.000219	0.001412	0.000527	0.000505	0.000805
23	PAPBD MILS	0.038109	0.001145	0.004818	0.000977	0.000015	0.000356	0.000562	0.002151	0.002111	0.018085
24	PRINT$PUBS	0.019010	0.001124	0.000812	0.001771	0.000479	0.001564	0.003929	0.002978	0.003458	0.002244
25	INDUS$CHEM	0.000135	0.000758	0.000040	0.000044	0.000000	0.000020	0.000039	0.000660	0.001348	0.000365
26	OTHER CHEM	0.002990	0.087504	0.002875	0.000351	0.000016	0.000489	0.002216	0.074416	0.005367	0.033335
27	PET REFINE	0.012652	0.001065	0.001025	0.047488	0.000085	0.014068	0.017740	0.006102	0.015793	0.009333
28	GLASSSTONE	0.005236	0.000194	0.000079	0.000105	0.000001	0.000049	0.000155	0.000195	0.003929	0.000247
29	CEM$CLAY	0.000620	0.000070	0.000270	0.029301	0.000024	0.000397	0.002062	0.001295	0.001991	0.000521
30	IRON$STEEL	0.000290	0.000037	0.000122	0.001254	0.000008	0.000685	0.000430	0.000320	0.001858	0.006964
31	NONFER MET	0.000096	0.000761	0.000064	0.000261	0.000001	0.000098	0.000123	0.000704	0.000157	0.000397
32	ALUMINUM	0.000029	0.000014	0.000009	0.000097	0.000001	0.000052	0.000031	0.000033	0.002639	0.010068
33	HEAVY METL	0.000322	0.000044	0.000163	0.003287	0.000020	0.001358	0.000470	0.000327	0.001634	0.000217
34	LITE METL	0.002474	0.000241	0.002419	0.003791	0.000007	0.001600	0.002271	0.000641	0.004628	0.002423
35	NONELC EQP	0.000018	0.000007	0.000004	0.000180	0.000000	0.002231	0.000450	0.001115	0.000238	0.000072
36	MACH TOOL	0.000429	0.000593	0.000066	0.012039	0.000003	0.001748	0.002359	0.001860	0.001899	0.000718
37	NONELC EQP	0.001149	0.000014	0.000027	0.011555	0.000000	0.002261	0.001936	0.002856	0.000415	0.000247
38	ELEC MACH	0.000106	0.000055	0.000033	0.000325	0.000014	0.000136	0.000144	0.000106	0.000101	0.000138
39	AEROSPACE	0.000067	0.000002	0.000005	0.000043	0.000000	0.000125	0.000138	0.000070	0.000061	0.000072
40	MOTOR VEH	0.000104	0.000004	0.000013	0.000169	0.000001	0.001260	0.000396	0.000221	0.000195	0.000127
41	SHIP BLDG	0.000079	0.000002	0.000005	0.000062	0.000000	0.000130	0.000144	0.000072	0.000066	0.000075
42	OTHER MFGS	0.000675	0.000426	0.000044	0.000160	0.000013	0.000088	0.000120	0.000420	0.000102	0.005379
43	TRANSPORT	0.040924	0.001177	0.002997	0.026697	0.000209	0.077131	0.085169	0.043220	0.037406	0.044282
44	ELEC COMPY	0.004178	0.000533	0.003115	0.008186	0.000103	0.001341	0.012090	0.007391	0.005581	0.006897
45	GAS COMPY	0.005585	0.000093	0.000168	0.006042	0.000045	0.000244	0.001814	0.001114	0.001745	0.003868
46	WATER SERV	0.001681	0.000038	0.000060	0.000171	0.000023	0.000125	0.000181	0.000973	0.000167	0.001811
47	COMMUNICAT	0.008959	0.014950	0.005385	0.005016	0.004273	0.007420	0.007287	0.007209	0.004439	0.009481
48	P,O $ MISC	0.004726	0.000621	0.002904	0.004944	0.000244	0.004118	0.004149	0.003306	0.003607	0.002718
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.043838	0.001728	0.010233	0.035176	0.000345	0.039523	0.060902	0.039663	0.048168	0.051472
52	FINANCE	0.007998	0.015720	0.005438	0.007473	0.008334	0.005090	0.006131	0.005757	0.003419	0.005517
53	INSURANCE	0.011267	0.016095	0.010150	0.014069	0.012475	0.008986	0.013721	0.012242	0.012907	0.013724
54	REA ESTATE	0.001334	0.000510	0.000582	0.001111	0.000335	0.000968	0.001477	0.001157	0.001252	0.001278
55	BUSI SERV	0.026611	0.001715	0.010568	0.014824	0.004716	0.006910	0.017110	0.015219	0.015116	0.007812
56	PERS SERV	0.008453	0.001230	0.005269	0.008311	0.000245	0.007297	0.009136	0.009452	0.009876	0.010044

TABLE A-5 DIRECT AND INDIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		21 PULPMILLS	22 PAPER MLLS	23 PAPBD MILS	24 PRINT$PUBS	25 INDUS$CHEM	26 OTHER CHEM	27 PET REFINE	28 GLASS$STONE	29 CEM$CLAY	30 IRON$STEEL
1	FIELD CROP	0.000001	0.000000	0.000000	0.000001	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
2	VEGETABLES	0.000013	0.000007	0.000008	0.000008	0.000004	0.000004	0.000007	0.000007	0.000018	0.000005
3	LVSTK$PROD	0.000024	0.000014	0.000016	0.000021	0.000008	0.000008	0.000014	0.000015	0.000033	0.000011
4	OTHER AGRI	0.000402	0.000174	0.000117	0.000013	0.000001	0.000003	0.000002	0.000010	0.000026	0.000005
5	FISHING	0.000007	0.000004	0.000004	0.000004	0.000002	0.000002	0.000004	0.000004	0.000010	0.000003
6	MEAT PRODS	0.000086	0.000048	0.000055	0.000044	0.000026	0.000023	0.000045	0.000045	0.000120	0.000035
7	DAIRY PROD	0.000030	0.000018	0.000020	0.000036	0.000011	0.000013	0.000020	0.000022	0.000040	0.000015
8	CANN$PRES	0.000096	0.000054	0.000061	0.000057	0.000030	0.000027	0.000052	0.000053	0.000134	0.000040
9	GRAIN MLLS	0.000046	0.000029	0.000032	0.000068	0.000017	0.000022	0.000033	0.000038	0.000060	0.000027
10	BEVERAGES	0.000021	0.000011	0.000013	0.000005	0.000006	0.000004	0.000009	0.000009	0.000029	0.000008
11	OTHR FOODS	0.000073	0.000052	0.000058	0.000161	0.000029	0.000049	0.000050	0.000076	0.000075	0.000083
12	TEXTILES	0.000005	0.000012	0.000810	0.000004	0.000004	0.000017	0.000001	0.000054	0.000021	0.000002
13	APPAREL	0.000261	0.000088	0.000087	0.000036	0.000028	0.000042	0.000023	0.000030	0.000046	0.000033
14	MINING	0.002178	0.001365	0.000405	0.000166	0.002242	0.000169	0.000084	0.013274	0.113316	0.002882
15	FORESTRY	0.039670	0.011800	0.010220	0.000782	0.000012	0.000164	0.000033	0.000769	0.000416	0.000084
16	LOGGING	0.192718	0.056102	0.049282	0.003695	0.000046	0.000782	0.000120	0.003686	0.001706	0.000298
17	SAWMILLS	0.033678	0.014564	0.009808	0.001054	0.000054	0.000201	0.000145	0.000814	0.002051	0.000330
18	PLYWOOD	0.006286	0.007455	0.003642	0.000513	0.000014	0.000074	0.000044	0.000311	0.000143	0.000096
19	OTHER WOOD	0.001854	0.000550	0.000855	0.000137	0.000114	0.000091	0.000560	0.000184	0.000457	0.001847
20	FURN$FIX	0.000015	0.000009	0.000009	0.000011	0.000004	0.000002	0.000011	0.000005	0.000012	0.000017
21	PULPMILLS	1.014866	0.034089	0.144214	0.002416	0.000058	0.001901	0.000091	0.009731	0.003641	0.000243
22	PAPER MLLS	0.001873	1.001187	0.022765	0.063987	0.000198	0.002951	0.000505	0.009145	0.002599	0.000532
23	PAPBD MILS	0.001053	0.013587	1.054495	0.002612	0.000378	0.013276	0.000548	0.069354	0.026145	0.001660
24	PRINT$PUBS	0.002259	0.002215	0.002663	1.026950	0.000878	0.005636	0.000996	0.020894	0.003857	0.003056
25	INDUS$CHEM	0.008939	0.001556	0.002199	0.000322	1.000171	0.008964	0.000802	0.000387	0.000145	0.000031
26	OTHER CHEM	0.010263	0.010643	0.010134	0.025742	0.018255	1.035193	0.000662	0.027034	0.002625	0.002322
27	PET REFINE	0.027811	0.021372	0.023726	0.003157	0.013104	0.010829	1.011545	0.005338	0.073397	0.004630
28	GLASS$STONE	0.000119	0.000065	0.000071	0.000085	0.000069	0.002278	0.000035	1.000078	0.000246	0.013761
29	CEM$CLAY	0.020739	0.001808	0.003299	0.000600	0.000250	0.000164	0.000463	0.007815	1.135371	0.010082
30	IRON$STEEL	0.002425	0.001014	0.001373	0.000278	0.000587	0.000266	0.000358	0.000287	0.010101	1.021367
31	NONFER MET	0.002222	0.000233	0.000444	0.000292	0.000291	0.008972	0.000112	0.000310	0.002535	0.004463
32	ALUMINUM	0.000143	0.000044	0.000055	0.000042	0.004522	0.000153	0.000048	0.000016	0.000194	0.000075
33	HEAVY METL	0.002220	0.000949	0.000550	0.000362	0.002336	0.000117	0.000677	0.000251	0.005613	0.000503
34	LITE METL	0.004158	0.001917	0.002319	0.003656	0.002687	0.002726	0.005212	0.000688	0.009002	0.002137
35	NONELC EQP	0.000474	0.000137	0.000125	0.000016	0.000006	0.000081	0.000005	0.000030	0.001745	0.000050
36	MACH TOOL	0.002443	0.000479	0.000647	0.000325	0.000298	0.006958	0.000224	0.000585	0.009442	0.001954
37	NONELC EQP	0.005017	0.004081	0.002502	0.000274	0.004440	0.000153	0.000012	0.000357	0.001475	0.000075
38	ELEC MACH	0.001727	0.000457	0.000340	0.000099	0.002323	0.000115	0.001243	0.000112	0.003568	0.004171
39	AEROSPACE	0.000087	0.000047	0.000054	0.000017	0.000024	0.000017	0.000039	0.000038	0.000123	0.000032
40	MOTOR VEH	0.000394	0.000140	0.000150	0.000035	0.000037	0.000032	0.000440	0.000082	0.003442	0.000113
41	SHIP BLDG	0.000097	0.000055	0.000063	0.000018	0.000029	0.000021	0.000434	0.000039	0.000151	0.000034
42	OTHER MFGS	0.001709	0.000478	0.001192	0.001456	0.002417	0.004787	0.000244	0.000274	0.000189	0.000095
43	TRANSPORT	0.053775	0.028911	0.033053	0.010313	0.014694	0.010448	0.023984	0.023136	0.075831	0.019818
44	ELEC COMPY	0.011111	0.016099	0.012755	0.006264	0.043528	0.003985	0.006171	0.016300	0.011690	0.021500
45	GAS COMPY	0.009314	0.015093	0.009508	0.002336	0.000144	0.000447	0.000514	0.013407	0.006204	0.008634
46	WATER SERV	0.003112	0.000790	0.000965	0.000234	0.000074	0.000106	0.000469	0.000198	0.001028	0.000185
47	COMMUNICAT	0.005332	0.004524	0.004254	0.011842	0.005388	0.003562	0.002089	0.008566	0.008222	0.007898
48	P,O $ MISC	0.007699	0.004759	0.004652	0.005785	0.001896	0.001117	0.005224	0.002503	0.004318	0.009070
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.052896	0.031966	0.038942	0.017730	0.010863	0.014748	0.003120	0.024912	0.044375	0.074406
52	FINANCE	0.007300	0.008500	0.009492	0.007925	0.005335	0.007890	0.003383	0.008514	0.013717	0.008515
53	INSURANCE	0.015051	0.012294	0.013747	0.012369	0.006012	0.010610	0.007079	0.015992	0.015663	0.010725
54	REA ESTATE	0.001316	0.000963	0.001109	0.001658	0.000493	0.000789	0.000568	0.001213	0.001384	0.003307
55	BUSI SERV	0.009542	0.007255	0.008577	0.014491	0.004412	0.008809	0.006823	0.016578	0.010733	0.016394
56	PERS SERV	0.008700	0.007543	0.007856	0.041411	0.005807	0.010566	0.013164	0.015865	0.010717	0.007526

TABLE A-5 DIRECT AND INDIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		31 NONFER MET	32 ALUMINUM	33 HEAVY METL	34 LITE METL	35 NONELC EQP	36 MACH TOOL	37 NONELC EQP	38 ELEC MACH	39 AEROSPACE	40 MOTOR VEH
1	FIELD CROP	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000001	0.000004	0.000003	0.000002	0.000002	0.000001	0.000001	0.000001	0.000000	0.000002
3	LVSTK$PROD	0.000003	0.000007	0.000006	0.000005	0.000005	0.000003	0.000003	0.000004	0.000001	0.000004
4	OTHER AGRI	0.000000	0.000004	0.000002	0.000001	0.000001	0.000002	0.000003	0.000001	0.000002	0.000018
5	FISHING	0.000001	0.000002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000000	0.000001
6	MEAT PRODS	0.000006	0.000024	0.000017	0.000015	0.000013	0.000006	0.000008	0.000009	0.000003	0.000012
7	DAIRY PROD	0.000005	0.000010	0.000008	0.000008	0.000007	0.000005	0.000005	0.000006	0.000002	0.000006
8	CANN$PRES	0.000008	0.000027	0.000020	0.000018	0.000016	0.000008	0.000010	0.000011	0.000004	0.C00014
9	GRAIN MLLS	0.000011	0.000016	0.000015	0.000014	0.000014	0.000011	0.000011	0.000011	0.000003	0.000010
10	BEVERAGES	0.000001	0.000005	0.000004	0.000003	0.000003	0.000001	0.000001	0.000001	0.000001	0.000002
11	OTHR FOODS	0.000035	0.000031	0.000044	0.000032	0.000040	0.000040	0.000034	0.000032	0.000007	0.000023
12	TEXTILES	0.000000	0.000002	0.000001	0.000006	0.000001	0.000008	0.000007	0.000004	0.000050	0.000007
13	APPAREL	0.000008	0.000359	0.000020	0.000013	0.000013	0.000045	0.000035	0.000014	0.000019	0.000035
14	MINING	0.013116	0.000250	0.000538	0.000201	0.000328	0.000295	0.000053	0.000233	0.000054	0.000308
15	FORESTRY	0.000006	0.000040	0.000042	0.000083	0.000018	0.000021	0.000091	0.000081	0.000033	0.000223
16	LOGGING	0.000023	0.000136	0.000175	0.000393	0.000067	0.000077	0.000332	0.000386	0.000110	0.000654
17	SAWMILLS	0.000029	0.000135	0.000106	0.000102	0.000084	0.000134	0.000257	0.000105	0.000166	0.001468
18	PLYWOOD	0.000008	0.000044	0.000036	0.000036	0.000022	0.000029	0.000086	0.000042	0.000286	0.002619
19	OTHER WOOD	0.000036	0.001092	0.000371	0.000081	0.000197	0.000146	0.002215	0.000056	0.000132	0.000218
20	FURN$FIX	0.000002	0.000005	0.000005	0.000002	0.000007	0.000011	0.000006	0.000002	0.000121	0.001236
21	PULPMILLS	0.000027	0.000076	0.000158	0.001099	0.000083	0.000091	0.000344	0.000787	0.000075	0.000242
22	PAPER MLLS	0.000143	0.000189	0.001813	0.000318	0.000200	0.000229	0.000344	0.002554	0.000383	0.000205
23	PAPBD MILS	0.000163	0.000511	0.000735	0.008003	0.000566	0.000612	0.002446	0.005178	0.000459	0.001730
24	PRINT$PUBS	0.001006	0.001338	0.001680	0.000996	0.001151	0.001245	0.003268	0.001029	0.002737	0.000998
25	INDUS$CHEM	0.000032	0.000334	0.000126	0.000063	0.001054	0.000030	0.000012	0.000031	0.000103	0.000039
26	OTHER CHEM	0.001752	0.000156	0.013164	0.005048	0.000456	0.000323	0.000215	0.001422	0.000699	0.003255
27	PET REFINE	0.020788	0.004268	0.005709	0.003179	0.003456	0.000941	0.000787	0.001149	0.001196	0.002477
28	GLASSSTONE	0.000016	0.000053	0.003948	0.002099	0.003086	0.005093	0.000113	0.002389	0.000235	0.002170
29	CEMSCLAY	0.000490	0.002095	0.001848	0.000300	0.000877	0.000739	0.000309	0.000200	0.000380	0.001057
30	IRON$STEEL	0.000096	0.002822	0.175337	0.016969	0.059490	0.020398	0.004568	0.004847	0.000310	0.065854
31	NONFER MET	1.323112	0.001821	0.001021	0.011064	0.009136	0.010842	0.000210	0.016852	0.000518	0.005365
32	ALUMINUM	0.000008	1.012409	0.008563	0.001915	0.003428	0.003418	0.001215	0.011664	0.001801	0.013705
33	HEAVY METL	0.000134	0.000137	1.013884	0.005637	0.005560	0.000370	0.000188	0.000080	0.000205	0.013831
34	LITE METL	0.002109	0.000619	0.002131	1.055992	0.016999	0.005549	0.005789	0.001371	0.001063	0.015650
35	NONELC EQP	0.000006	0.000007	0.000048	0.000046	1.006587	0.011174	0.000029	0.000030	0.000070	0.000010
36	MACH TOOL	0.000193	0.000133	0.003599	0.003879	0.029100	1.022652	0.002251	0.002412	0.006286	0.000312
37	NONELC EQP	0.000156	0.000669	0.000063	0.000062	0.010822	0.009724	1.008474	0.000059	0.000159	0.000033
38	ELEC MACH	0.000057	0.000093	0.004598	0.000142	0.005740	0.005042	0.005374	1.005815	0.003427	0.002794
39	AEROSPACE	0.000002	0.000022	0.000015	0.000011	0.000010	0.000002	0.000005	0.000005	1.012601	0.000010
40	MOTOR VEH	0.000024	0.000039	0.000044	0.000020	0.000031	0.000021	0.000020	0.000017	0.000006	1.006079
41	SHIP BLDG	0.000010	0.000024	0.000017	0.000012	0.000011	0.000003	0.000005	0.000006	0.000003	0.000011
42	OTHER MFGS	0.000035	0.000030	0.000119	0.000077	0.000210	0.005057	0.003366	0.000048	0.001888	0.001328
43	TRANSPORT	0.001438	0.013591	0.009038	0.006783	0.006262	0.001448	0.003077	0.003346	0.001440	0.006075
44	ELEC COMPY	0.013739	0.055283	0.013595	0.009565	0.007449	0.010704	0.005689	0.006845	0.002503	0.004209
45	GAS COMPY	0.019652	0.002121	0.001661	0.004142	0.000853	0.000560	0.002322	0.002823	0.000648	0.000834
46	WATER SERV	0.000073	0.000087	0.000106	0.000079	0.000120	0.001661	0.000076	0.000086	0.000190	0.000066
47	COMMUNICAT	0.004318	0.002397	0.005573	0.004802	0.003793	0.006183	0.003343	0.005645	0.005616	0.003921
48	P,0 $ MISC	0.001296	0.002439	0.002505	0.001138	0.003566	0.005905	0.002954	0.001053	0.002149	0.004795
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	0.017845	0.014202	0.032718	0.010383	0.025627	0.024388	0.019952	0.015937	0.003053	0.011669
52	FINANCE	0.004129	0.003758	0.008580	0.008473	0.003599	0.005966	0.005145	0.003100	0.001129	0.005083
53	INSURANCE	0.009625	0.013936	0.012485	0.011751	0.010760	0.009775	0.012032	0.008343	0.002740	0.009507
54	REA ESTATE	0.000636	0.000612	0.001280	0.000696	0.000830	0.000804	0.000771	0.003009	0.000190	0.000746
55	BUSI SERV	0.006879	0.006018	0.012364	0.009480	0.004895	0.007227	0.012714	0.008728	0.005018	0.017801
56	PERS SERV	0.006047	0.005470	0.005478	0.006675	0.005827	0.006058	0.005316	0.005623	0.001282	0.003904

TABLE A-5 DIRECT AND INDIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		41 SHIP BLDG	42 OTHER MFGS	43 TRANSPORT	44 ELEC COMPY	45 GAS COMPY	46 WATER SERV	47 COMMUNICAT	48 P,O $ MISC	49 HOUSING	50 HIGHWAYS
1	FIELD CROP	0.000000	0.000000	0.000007	0.000000	0.000000	0.000030	0.000000	0.000000	0.000000	0.000000
2	VEGETABLES	0.000002	0.000003	0.000223	0.000004	0.000001	0.000001	0.000001	0.000007	0.000006	0.000009
3	LVSTK$PROD	0.000004	0.000006	0.000390	0.000008	0.000002	0.000004	0.000003	0.000013	0.000011	0.000017
4	OTHER AGRI	0.000015	0.000082	0.000032	0.000007	0.000004	0.000005	0.000005	0.000216	0.000553	0.000046
5	FISHING	0.000001	0.000001	0.000119	0.000002	0.000000	0.000031	0.000001	0.000003	0.000003	0.000005
6	MEAT PRODS	0.000011	0.000017	0.001521	0.000028	0.000004	0.000007	0.000006	0.000043	0.000038	0.000061
7	DAIRY PROD	0.000005	0.000009	0.000443	0.000011	0.000004	0.000007	0.000005	0.000017	0.000014	0.000022
8	CANN$PRES	0.000013	0.000020	0.001661	0.000032	0.000006	0.000010	0.000008	0.000049	0.000043	0.000068
9	GRAIN MLLS	0.000010	0.000016	0.000589	0.000019	0.000008	0.000013	0.000009	0.000030	0.000025	0.000034
10	BEVERAGES	0.000002	0.000003	0.000384	0.000006	0.000000	0.000001	0.000001	0.000010	0.000009	0.000014
11	OTHR FOODS	0.000024	0.000036	0.000161	0.000033	0.000019	0.000032	0.000023	0.000080	0.000060	0.000057
12	TEXTILES	0.000008	0.001522	0.000008	0.000001	0.000000	0.000000	0.000002	0.000016	0.000010	0.000002
13	APPAREL	0.000468	0.006355	0.000445	0.000058	0.000033	0.000039	0.000043	0.001371	0.001112	0.000056
14	MINING	0.000346	0.000047	0.001111	0.000336	0.000193	0.000285	0.000324	0.011447	0.008604	0.068898
15	FORESTRY	0.000175	0.000379	0.000185	0.000062	0.000032	0.000039	0.000062	0.001622	0.004204	0.000403
16	LOGGING	0.000532	0.001198	0.000603	0.000204	0.000097	0.000110	0.000228	0.004507	0.011550	0.001161
17	SAWMILLS	0.001018	0.003417	0.000875	0.000493	0.000296	0.000406	0.000409	0.017436	0.046001	0.003785
18	PLYWOOD	0.001785	0.000133	0.000255	0.000111	0.000064	0.000087	0.000096	0.003639	0.009312	0.001826
19	OTHER WOOD	0.000931	0.003113	0.004722	0.000337	0.000163	0.000229	0.000220	0.009717	0.025355	0.001949
20	FURN$FIX	0.000418	0.000002	0.000057	0.000051	0.000031	0.000044	0.000040	0.001894	0.001029	0.000008
21	PULPMILLS	0.000191	0.000592	0.000232	0.000071	0.000029	0.000015	0.000096	0.000393	0.000305	0.000306
22	PAPER MLLS	0.000653	0.003252	0.000389	0.001275	0.000334	0.000086	0.002267	0.000750	0.000579	0.000505
23	PAPBD MILS	0.001249	0.003585	0.001611	0.000218	0.000135	0.000088	0.000172	0.002713	0.002102	0.002128
24	PRINT$PUBS	0.001798	0.001211	0.003099	0.004437	0.004781	0.000703	0.003839	0.004105	0.003004	0.002414
25	INDUS$CHEM	0.000059	0.000067	0.000130	0.000017	0.000004	0.007524	0.000010	0.000091	0.000140	0.000071
26	OTHER CHEM	0.005488	0.005078	0.005247	0.000383	0.000267	0.000355	0.000277	0.005961	0.010080	0.002640
27	PET REFINE	0.001582	0.001402	0.089630	0.008735	0.000527	0.000831	0.004527	0.021423	0.017788	0.050268
28	GLASS$STONE	0.000762	0.000145	0.000200	0.000091	0.000059	0.000074	0.000065	0.002488	0.001962	0.001954
29	CEM$CLAY	0.002647	0.000207	0.002925	0.002310	0.001423	0.001983	0.002569	0.085400	0.061557	0.073536
30	IRON$STEEL	0.020976	0.003631	0.002466	0.001608	0.000505	0.001179	0.000617	0.021794	0.018110	0.015668
31	NONFER MET	0.003093	0.000465	0.000508	0.001349	0.000138	0.000081	0.000121	0.002765	0.001777	0.002511
32	ALUMINUM	0.000184	0.018250	0.000111	0.000044	0.000032	0.000089	0.000074	0.000959	0.001336	0.000228
33	HEAVY METL	0.002646	0.000231	0.001358	0.001195	0.000774	0.004826	0.001596	0.042416	0.021715	0.022579
34	LITE METL	0.006357	0.023858	0.003610	0.002787	0.008741	0.000274	0.000275	0.008199	0.007569	0.001275
35	NONELC EQP	0.002519	0.000041	0.000091	0.000009	0.000004	0.000005	0.000007	0.000195	0.000167	0.000172
36	MACH TOOL	0.002791	0.003263	0.007040	0.000239	0.000110	0.000125	0.000124	0.004348	0.003401	0.005058
37	NONELC EQP	0.001315	0.000074	0.000099	0.000016	0.000006	0.000040	0.000017	0.000241	0.000264	0.000858
38	ELEC MACH	0.006775	0.004573	0.000836	0.001042	0.000064	0.000112	0.003055	0.002941	0.001601	0.000502
39	AEROSPACE	0.000010	0.000012	0.001640	0.000026	0.000001	0.000002	0.000003	0.000041	0.000038	0.000061
40	MOTOR VEH	0.000028	0.000023	0.001690	0.000045	0.000007	0.000010	0.000017	0.000344	0.000269	0.000318
41	SHIP BLDG	1.001242	0.000013	0.001659	0.000029	0.000001	0.000002	0.000005	0.000049	0.000044	0.000080
42	OTHER MFGS	0.002660	1.049336	0.000535	0.000071	0.000043	0.000060	0.000734	0.001129	0.000486	0.000132
43	TRANSPORT	0.005923	0.007683	1.008682	0.015728	0.000722	0.001077	0.001793	0.024968	0.023174	0.037306
44	ELEC COMPY	0.003496	0.012232	0.005807	1.149170	0.000337	0.009304	0.006499	0.004414	0.005128	0.003090
45	GAS COMPY	0.000802	0.003343	0.001528	0.000200	1.000110	0.000083	0.000149	0.001064	0.000868	0.001174
46	WATER SERV	0.000477	0.000090	0.000562	0.000549	0.000048	1.000065	0.000073	0.000561	0.000187	0.000219
47	COMMUNICAT	0.003271	0.007474	0.011430	0.004212	0.004836	0.000854	1.008776	0.008982	0.006416	0.006678
48	P,O $ MISC	0.001269	0.001258	0.028840	0.026898	0.016657	0.023217	0.021366	1.003697	0.003029	0.004253
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
51	WHSLE$RET	0.015157	0.011824	0.024426	0.014381	0.001868	0.002578	0.007664	0.068185	0.053202	0.039225
52	FINANCE	0.002986	0.007299	0.005061	0.003735	0.004741	0.008432	0.003331	0.008365	0.006030	0.006269
53	INSURANCE	0.008068	0.011112	0.014093	0.011896	0.009230	0.008697	0.010847	0.013528	0.010305	0.010970
54	REA ESTATE	0.000657	0.000841	0.001339	0.000782	0.000478	0.000567	0.001912	0.001868	0.001292	0.001457
55	BUSI SERV	0.016310	0.022510	0.015718	0.022281	0.014254	0.009804	0.012550	0.040376	0.018245	0.047046
56	PERS SERV	0.003632	0.007501	0.024451	0.006167	0.004862	0.008350	0.004859	0.007954	0.005626	0.007331

TABLE A-5 DIRECT AND INDIRECT INPUT COEFFICIENTS 1980
PUGET SOUND AND ADJACENT WATERS

		51 WHSLE$RET	52 FINANCE	53 INSURANCE	54 REA ESTATE	55 BUSI SERV	56 PERS SERV
1	FIELD CROP	0.000001	0.000000	0.000000	0.000000	0.000000	0.000014
2	VEGETABLES	0.000006	0.000004	0.000003	0.000005	0.000003	0.000138
3	LVSTK$PROD	0.000014	0.000009	0.000005	0.000011	0.000008	0.000421
4	OTHER AGRI	0.000005	0.000003	0.000002	0.000020	0.000007	0.000019
5	FISHING	0.000003	0.000002	0.000001	0.000003	0.000002	0.000074
6	MEAT PRODS	0.000033	0.000025	0.000017	0.000030	0.000018	0.000720
7	DAIRY PROD	0.000024	0.000015	0.000008	0.000018	0.000014	0.000800
8	CANN$PRES	0.000041	0.000030	0.000020	0.000037	0.000023	0.001027
9	GRAIN MLLS	0.000103	0.000027	0.000013	0.000033	0.000026	0.001534
10	BEVERAGES	0.000009	0.000004	0.000004	0.000005	0.000002	0.000022
11	OTHR FOODS	0.000809	0.000061	0.000028	0.000081	0.000066	0.003727
12	TEXTILES	0.000005	0.000002	0.000001	0.000002	0.000005	0.000006
13	APPAREL	0.000041	0.000046	0.000029	0.000164	0.000779	0.000084
14	MINING	0.000168	0.000146	0.000061	0.001015	0.000070	0.000419
15	FORESTRY	0.000127	0.000048	0.000033	0.000189	0.000035	0.000086
16	LOGGING	0.000547	0.000190	0.000140	0.000618	0.000146	0.000289
17	SAWMILLS	0.000363	0.000242	0.000109	0.001584	0.000127	0.000599
18	PLYWOOD	0.000111	0.000062	0.000032	0.000351	0.000038	0.000339
19	OTHER WOOD	0.000649	0.000166	0.000088	0.000919	0.000084	0.000318
20	FURN$FIX	0.000025	0.000022	0.000008	0.000165	0.000010	0.000048
21	PULPMILLS	0.000839	0.000172	0.000138	0.000198	0.000089	0.000170
22	PAPER MLLS	0.003717	0.001729	0.001577	0.003720	0.002000	0.001525
23	PAPBD MILS	0.005285	0.000852	0.000642	0.000573	0.000184	0.000887
24	PRINT$PUBS	0.025895	0.025774	0.016384	0.056384	0.018971	0.013861
25	INDUS$CHEM	0.000045	0.000021	0.000018	0.000124	0.000018	0.000059
26	OTHER CHEM	0.000922	0.000816	0.000516	0.003401	0.000603	0.002228
27	PET REFINE	0.013314	0.004566	0.001561	0.032071	0.003519	0.011952
28	GLASS$STONE	0.000225	0.000035	0.000016	0.000232	0.000025	0.000121
29	CEM$CLAY	0.001116	0.001012	0.000393	0.007469	0.000466	0.002204
30	IRON$STEEL	0.000453	0.000296	0.000128	0.001985	0.000392	0.000764
31	NONFER MET	0.000081	0.000052	0.000023	0.000311	0.000030	0.000162
32	ALUMINUM	0.000038	0.000027	0.000007	0.000092	0.000034	0.000048
33	HEAVY METL	0.000920	0.000563	0.000244	0.003846	0.001715	0.001634
34	LITE METL	0.000686	0.000330	0.000169	0.001300	0.000245	0.004538
35	NONELC EQP	0.000186	0.000006	0.000004	0.000023	0.000005	0.000024
36	MACH TOOL	0.000177	0.000137	0.000088	0.000486	0.000080	0.000990
37	NONELC EQP	0.000261	0.000016	0.000012	0.000044	0.000014	0.000042
38	ELEC MACH	0.000161	0.000115	0.000054	0.000364	0.000097	0.000179
39	AEROSPACE	0.000022	0.000016	0.000015	0.000021	0.000008	0.000015
40	MOTOR VEH	0.000710	0.000031	0.000024	0.000076	0.000022	0.000062
41	SHIP BLDG	0.000027	0.000018	0.000015	0.000033	0.000009	0.000021
42	OTHER MFGS	0.000487	0.000754	0.000069	0.000260	0.000821	0.000358
43	TRANSPORT	0.013719	0.010097	0.008954	0.012769	0.005006	0.009316
44	ELEC COMPY	0.017754	0.005974	0.001497	0.031075	0.003625	0.013626
45	GAS COMPY	0.002087	0.001577	0.002163	0.009813	0.001690	0.001184
46	WATER SERV	0.001299	0.000849	0.001115	0.008262	0.000899	0.003381
47	COMMUNICAT	0.025787	0.020731	0.010561	0.013306	0.020588	0.022354
48	P,O $ MISC	0.012553	0.011606	0.004432	0.087542	0.005202	0.025539
49	HOUSING	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50	HIGHWAYS	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
51	WHSLE$RET	1.021063	0.014505	0.011998	0.031048	0.016439	0.053717
52	FINANCE	0.013008	1.057673	0.007797	0.012329	0.008040	0.009496
53	INSURANCE	0.010539	0.008035	1.060176	0.024921	0.011167	0.012541
54	REA ESTATE	0.014596	0.016362	0.013202	1.048754	0.012183	0.026110
55	BUSI SERV	0.019346	0.029707	0.026670	0.056813	1.064763	0.028750
56	PERS SERV	0.015987	0.013919	0.005146	0.016122	0.014977	1.037931

Before splitting the 1963 consumption column into the two components, adjustments were made for import substitutes. In this process the total consumption by sector was estimated from national data, given PS&AW 1963 income. Known purchases from regional industries were subtracted and the residual represented the presumed imports. However, since the total imports by consumers was given, only the percentage distribution of presumed imports was applied. Thus, we had estimates of locally supplied and imported goods and services, by sector, for consumption. Adjusting the direct consumption coefficients for import substitution also involved comparison with the San Francisco Bay Area table. And here again, judgment had to be applied.

The column of marginal propensities to consume was derived from a combination of national and local data. Given the column of local average propensities, we multiplied these by the income elasticity of demand to generate marginal coefficients. The estimates used for income elasticity were taken from Projections 1970, the B.L.S. publication. That source gave both consumption by U.S. I-O sectors and GNP for 1958 and a projected 1970. The one elasticity over that period was used as the income elasticity of demand.

One reason for selecting this source, as opposed to, say Almon, was that these data, in effect, measured more than income elasticity. Over this period changes in relative prices are also reflected. Thus, while the future may not be a pure income elasticity, they better suit our purposes.

State and local government purchases and investment were treated separately at first. Finally, efforts to generate a time series regression and various independent variables on investment did not work out well. About the best fit came against total employment. State and local government spending was highly correlated with changes in estimated total personal income.

We made both investment and state and local governments a simple function of local income. For operational purposes, then, column 57 represents a sector of average aggregate propensities to invest and purchase by state and local governments. In addition, those Federal activities estimated as endogenous such as the Post Office were included with state and local spending. The rows corresponding to columns 55, 56 and 57, were a set of average income coefficients, a marginal coefficients sector and coefficients representing nonpersonal income value added. These were described in (13), (14), and (15) above.

The share of value added not going to personal income, v_i^m, was determined by industry from national data. The v_i^e and v_i^i were determined from national productivity estimates generated by Almon, i.e., *given the v_i^n and v_i^i coefficient*, the v_i^e was determined as a residual.

Clearly, the row sum across row 55 was addressed to column 55, row 56 to column 56 and row 57 to column 57. In other words, extensive income triggered the average propensity to consume column, intensive income the marginal propensity to consume column and nonpersonal income value added, the investment and state and local column. The last was done, not alone for computational conveneince, but also because investment might be more clearly related to non-personal income value added, a large part of which is depreciation.

These steps produced a direct coefficients table for the 57 by 57 1980 projection model. Given the four final demands and/or the independent projections of total output, the model can be solved to yield total output and value added. Also given (15) above, total employment can be determined.

In adjusting the $rc^{t}ij$'s, noted in (7), account was taken of technological change using data derived by Almon. For example, if Almon projected a 20 percent increase in the national a_{ij}, we raised the $_{rc}t_{ij}$ by 20 percent. For those exports tied to the consumption sector outside of Washington, personal income was used as the denomination for consumption estimates. Since the Harris projection, cited below, not only estimated income, but population as well, it was possible to estimate increased per capita income in California-Oregon and the rest of the U.S. Applying the same income elasticities used for the Washington consumption column, it was possible to account for marginal versus average propensities to consume Washington products in the two receiving regions.